PRELIMINARY NOISE ANALYSIS

East-West Freeway: Branders Bridge Road to US 1

Chesterfield County, VA

PROJECT#: N/A (CDOT project)
UPC#: N/A (CDOT Project)

Prepared for:

Chesterfield County, Virginia
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Under the Guidance and Review of:

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PRELIMINARY NOISE ANALYSIS TECHNICAL REPORT

1. EXECUTIVE SUMMARY

A preliminary noise evaluation was performed and a more detailed review will be completed during final design. As such, noise barriers that are found to be feasible and reasonable during the preliminary noise analysis may also not be found to be feasible and reasonable during the final design noise analysis. Conversely, noise barriers that were not considered feasible and reasonable may meet the established criteria and be recommended for construction.

The proposed grade-separated, limited-access highway would have four lanes, two in each direction, separated by a median. The proposed highway corridor may also include a conceptual paralleling and/or crossing corridor that would include a freight rail connection from the CSX line east of U.S. Route 1 to an area just west of Branders Bridge Road. The total length of the proposed project would be approximately two-and-a-half miles. ***Figure 1*** in Appendix A shows the location of the study area.

A total of 218 noise sensitive sites were modeled in the project study area representing 301 single and multi-family residential units (Category B), one Place of Worship (Category D, interior) and one outdoor hotel pool (Category E). Category F land uses (retail, industrial, etc.) were not analyzed as these sites do not have a noise impact criteria per 23CFR772.

There are no noise receptors that are predicted to approach equal or exceed the Noise Abatement Category (NAC) criteria in the existing condition. Ninety residences, represented by 90 noise sensitive sites and a Place of Worship are predicted to be impacted by traffic noise under the design year build (2042) noise levels due to levels approaching or exceeding the NAC criteria and/or meeting the substantial increase impact criterion. For all sites studied, the existing year noise levels are predicted to range from 40 to 65 dBA. The future design year (2042) build noise levels are predicted to range from 50 to 68 dBA.

Noise abatement measures were evaluated for new barrier locations where future noise impacts were predicted to occur. The barriers were not found to meet both the feasible and reasonable criteria under VDOT's State Noise Abatement Policy. As a result, mitigation is not proposed to be carried into final design, pending the final design of the roadway and the development of the railroad line, as applicable.

Construction activity may cause intermittent fluctuations in noise levels. During the construction phase of the project, all reasonable measures will be taken to minimize noise impact from these activities.

2. INTRODUCTION

A preliminary noise evaluation was performed for the East-West Freeway and a more detailed review will be completed during final design. As such, noise barriers that are found to be feasible and reasonable during the preliminary noise analysis may also not be found to be feasible and reasonable during the final

design noise analysis. Conversely, noise barriers that were not considered feasible and reasonable may meet the established criteria and be recommended for construction.

The new alignment highway is proposed to be a grade-separated, limited-access highway and would have four lanes, two in each direction, separated by a median. Two interchanges ae proposed with Harrowgate Road and with US 1. The proposed corridor would also include a conceptual freight rail connection from the CSX line east of U.S. Route 1 to an area just west of Branders Bridge Road to potentially accommodate future commercial development. The total length of the proposed project would be approximately two-and-a-half miles. ***Figure 1*** in Appendix A shows the location of the study area.

The purpose of the East-West Freeway project from Branders Bridge Road to I-95 is the following:

- Identify and preserve a corridor that is compatible with and limits encroachment upon a future limited access thoroughfare;
- Provide improved access for existing land uses near Branders Bridge Road to US 1 /I-95;
- Reduce traffic cut-through in adjacent neighborhoods; and
- Provide sufficient right of way width to allow for future addition of rail.

The study area is located generally within the Branders Bridge Road Area and Interstate 95. This area is in need for an east-west transportation route and Chesterfield County identified the East-West Freeway in its 1989 Thoroughfare Plan and continues to be listed in the most recent Thoroughfare Plan. The area is also identified in the County's Comprehensive Plan as a targeted growth area that is supported by the County's Land Use Plan, which identified property appropriate for commercial and industrial development west of Branders Bridge Road. This property would require rail access. Therefore, there is a need to preserve the transportation corridor, enhance east-west access, and possibly add a rail corridor.

This is a Chesterfield County project and is not a VDOT project nor is it on the Transportation Improvement Program. The objective of this analysis is to assess the potential traffic noise impacts associated with the proposed roadway improvement project in the design year 2042, and to evaluate potential noise abatement measures wherever impacts are predicted to occur. A conceptual railroad line component was also analyzed for noise impacts in conjunction with the highway construction.

This report also documents a description of noise terminology, the applicable standards and criteria, a description of the computations of existing and future noise levels, a projection of future noise levels, identification of potential noise impacts, evaluate measures to mitigate noise impacts, noise abatement and a discussion of construction noise.

3. METHODOLOGY

3.1 REGULATORY REQUIREMENTS

The Noise Control Act of 1972 gives the US Environmental Protection Agency (USEPA) the authority to establish noise regulations to control major noise sources, including motor vehicles and construction equipment. Furthermore, the USEPA is required to set noise emission standards for motor vehicles used for interstate commerce and the FHWA is required to enforce the USEPA noise emission standards through the Office of Motor Carrier Safety. The National Environmental Policy Act (NEPA) of 1969

gives broad authority and responsibility to Federal agencies to evaluate and mitigate adverse environmental impacts caused by Federal actions. FHWA is required to comply with NEPA including mitigating adverse highway traffic noise effects. The Federal-Aid Highway Act of 1970 mandates FHWA to develop standards for mitigating highway traffic noise. It also requires FHWA to establish traffic noise level criteria for various types of land uses. The Act prohibits FHWA approval of federal-aid highway projects unless adequate consideration has been made for noise abatement measures to comply with the standards. FHWA regulations for highway traffic noise for federal-aid highway projects are contained in 23 CFR 772. The regulations contain noise abatement criteria, which represent the maximum acceptable level of highway traffic noise for specific types of land uses. The regulations do not mandate that the abatement criteria be met in all situations, but rather require that reasonable and feasible efforts be made to provide noise mitigation when the abatement criteria are approached or exceeded.

The State Noise Abatement Policy was developed to implement the requirements of 23 Code of Federal Regulations (CFR) Part 772 Procedures for Abatement of Highway Traffic Noise and Construction Noise (July 13, 2011), FHWA's Highway Traffic Noise Analysis and Abatement Policy and Guidance (December 2011), and the noise related requirements of The National Environmental Policy Act of 1969. The current VDOT State Noise Abatement Policy became effective on July 13, 2011 and was updated several times. The current update is dated July 14, 2015 (Version 7). This policy is applicable to Type I federal-aid highway projects which involves the physical alteration of an existing highway that significantly changes either the horizontal or vertical alignment.

3.2 TRAFFIC NOISE DESCRIPTORS

Noise is generally defined as unwanted or annoying sound. Airborne sound occurs by a rapid fluctuation of air pressure above and below atmospheric pressure. Sound pressure levels are usually measured and expressed in decibels (dB). The decibel scale is logarithmic and expresses the ratio of the sound pressure unit being measured to a standard reference level.

Most sounds occurring in the environment do not consist of a single frequency, but rather a broad band of differing frequencies. The intensities of each frequency add to generate sound. Because the human ear does not respond to all frequencies equally, the method commonly used to quantify environmental noise consists of evaluating all of the frequencies of a sound according to a weighting system. It has been found that the A-weighted filter on a sound level meter, which includes circuits to differentially measure selected audible frequencies, best approximates the frequency response of the human ear.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a conglomeration of noise from distant sources, creating a relatively steady background noise in which no particular source is identifiable. To describe the time-varying character of traffic noise, a statistical noise descriptor called the equivalent hourly sound level, or Leq (h), is commonly used. Leq (h) describes a noise sensitive receptor's cumulative exposure from all noise-producing events over a one-hour period.

Because decibels are logarithmic units, sound levels cannot be added by ordinary arithmetic means. The following general relationships provide a basic understanding of sound generation and propagation:

- An increase, or decrease, of 10 dB will be perceived by a receptor to be a doubling, or halving, of the sound level.
- Doubling the distance between a highway and receptor will produce a 3 dB sound level decrease.
- A 3 dB sound level increase is barely detectable by the human ear.

3.3 NOISE ABATEMENT CRITERIA

The State Noise Abatement Policy has adopted the NAC that have been established by FHWA (23 CFR 772) for determining traffic noise impacts for a variety of land uses. The NAC, listed in Table 1 for various activities, represent the upper limit of acceptable traffic noise conditions and also a balancing of that which may be desirable with that which may be achievable. The NAC applies to areas having regular human use and where lowered noise levels are desired. They do not apply to the entire tract of land on which the activity is based, but only to that portion where the activity takes place.

The NAC is given in terms of the hourly, A-weighted, equivalent sound level in decibels (dBA). The noise impact assessment is made using the guidelines listed in Table 1. Noise-sensitive sites potentially affected by this project are classified as Category B, D and E.

3.4 DEFINITION OF NOISE IMPACT

Traffic noise impacts occur if either of the following two conditions is met:

- The predicted traffic noise levels approach or exceed the NAC, as shown in Table 1. The VDOT State Noise Abatement Policy defines an approach level to be used when determining a traffic noise impact. The approach level shall be 1 dB(A) less than the Noise Abatement Criteria for Activity Categories A to E. For example, for a category B receptor, 66 dBA would be approaching 67 dBA and would be considered an impact. If design year noise levels "approach or exceed" the NAC, then the activity is impacted and a series of abatement measures must be considered.
- The predicted traffic noise levels are substantially higher than the existing noise levels. The VDOT State Noise Abatement Policy defines a substantial noise increase as when predicted highway traffic noise levels exceed existing noise levels by 10 dBA or more. For example, if a receptor's existing noise level is 50 dBA, and if the future noise level is 60 dBA, then it would be considered an impact. The noise levels of the substantial increase impact do not have to exceed the appropriate NAC.

If traffic noise impact is identified within the project corridor, then consideration of noise abatement measures is necessary. The final decision on whether or not to provide noise abatement along a project corridor will take into account the feasibility of the design and overall cost weighted against the environmental benefit.

TABLE 1: FHWA NOISE ABATEMENT CRITERIA

TABLE 1 TO PART 772—NOISE ABATEMENT CRITERIA [Hourly A–Weighted Sound Level decibels (dB(A))[1]]				
Activity category	**Activity Leq(h)[4]**	**Criteria[2] L10(h)**	**Evaluation location**	**Activity description**
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	67	70	Exterior	Residential.
C[3]	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.
F			Exterior	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G				Undeveloped lands that are not permitted.

[1] Either Leq(h) or L10(h) (but not both) may be used on a project.
[2] The Leq(h) and L10(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
[3] Includes undeveloped lands permitted for this activity category.
[4] VDOT uses the Leq(h) designation

3.5 HIGHWAY NOISE COMPUTATION MODEL

A review of the project corridor has established roadway traffic as the dominant source of noise for the build alternative. Since roadway noise can be determined accurately through computer modeling techniques for areas that are dominated by road traffic, design year traffic noise calculations have been performed using the Federal Highway Administration's Traffic Noise Model (FHWA TNM®) Version 2.5, which is the latest approved version. The FHWA TNM ® was developed and sponsored by the U. S. Department of Transportation and John A. Volpe National Transportation Systems Center, Acoustics facility. The TNM estimates vehicle noise emissions and resulting noise levels based on reference energy mean emission levels. The existing and proposed alignments (horizontal and vertical) are input into the model, along with the receptor locations, traffic volumes of cars, medium trucks (vehicles with 2 axles and 6 tires,) heavy trucks, average vehicle speeds, pavement type, and any traffic control devices. The TNM uses its acoustic algorithms to predict noise levels at the selected receptor locations by taking into account sound propagation variables such as, atmospheric absorption, divergence, intervening ground, barriers, building rows, and sometimes heavy vegetation.

3.6 DATA SOURCES

3.6.1 ROADWAYS AND ALIGNMENTS

The survey/design files for the existing conditions and the proposed build alternative were developed by the Timmons Group. Design files were converted to DXF files that were then imported into the TNM.

3.6.2 TRAFFIC VOLUMES AND FLOW CONTROL

Traffic data development methodology for traffic noise computations were developed by Chesterfield Department of Transportation (CDOT) and approved by VDOT as hourly volumes and operating speeds by roadway segment for the existing and future design-year (2042) build conditions. The noise analysis was performed for the loudest hour of the day and was considered to be the predicted peak hour volumes. The proposed posted speed for the East-West Freeway is 55 mph. The posted speeds were used for the cross-streets.

3.6.3 RECEPTORS

A total of 218 noise sensitive sites were modeled in the project study area representing 301 single and multi-family residential units (Category B), one Place of Worship (Category D, interior) and one outdoor hotel pool (Category E). Category F land uses (retail, industrial, etc.) were not analyzed as these sites do not have a noise impact criteria per 23CFR772.

The location of all the receptors modeled in TNM can be found in Appendix A. Receptor locations were identified based on available existing mapping, aerial photo reviews, Google Street Views and site visits. Specific receptor placement in the model is generally based on exterior areas where there is frequent human use.

3.6.4 TERRAIN LINES

Terrain lines (elevation contours) were used in the model to represent important and intervening terrain features associated with the proposed project. Contour elevations were provided by Timmons Engineering. Terrain lines were created from the contour elevations by the noise analyst to provide the most realistic sound level environment.

3.6.5 BARRIERS

Preliminary proposed barriers were evaluated in the project corridor for noise abatement evaluation. Refer to ***Section 6.4*** for the barrier discussions.

4. EXISTING NOISE ENVIRONMENT

To assess existing noise conditions within the project study area, short term noise monitoring was conducted. During the noise monitoring, a windshield survey of noise-sensitive land uses and identification of major sources of acoustical shielding was conducted to supplement the mapping provided.

Noise monitoring was conducted in the vicinity of noise-sensitive land uses near the proposed project alignment. The noise monitoring characterized existing noise levels in the study area but were not necessarily conducted during the loudest hour of the day. The monitoring data can be used as the baseline against which probable future noise levels are compared and potential impacts assessed. A validation

exercise was carried out to evaluate the accuracy of the noise prediction model, and is presented in ***Section 4.1***, along with additional information about the computation methods.

4.1 NOISE MONITORING

The purpose of noise monitoring is to gather data that is used to develop a comparison between the monitored results and the output obtained from the noise prediction model. This exercise is performed to validate the model so that it can be used with confidence to determine the worst hour noise levels, and predict the future noise levels.

Short-term noise measurements of 20 minutes duration were obtained at a total of nine sites on October 3rd and 4th, 2017 within the project corridor. These short-term measurements were collected using a Norsonics 132 sound level meter. Prior to noise monitoring, the noise meter was calibrated to 94 dB using the Extech 407744 acoustic calibrator. Readings were in the A-weighted scale and were reported in decibels (dBA). Data collected by the noise meter included time, average noise level (Leq), maximum noise level (Lmax), and instantaneous peak noise level (Lpk) for each interval. Hourly average noise levels (Leq (h)) were derived at each location from the 20 minute Leq values. Existing noise measurements were collected under meteorologically acceptable conditions when the pavement was dry and winds were calm or light. Additional data collected at each monitoring location included atmospheric conditions such as wind speed, humidity, and ambient temperature. Measurements were conducted based on the acceptable collection of existing noise level readings according to the FHWA Report, FHWA-PD-96-046, "Measurement of Highway Related Noise."

A summary of the short-term noise monitoring results are presented in Table 2. For each site, the table lists the assigned site number, the location and a description of the associated land use for each site, the monitored sound level, and the dominant sources of noise at each site. Traffic data (vehicle volume composition and speed) were also recorded on all roadways which were visible from the monitoring site and significantly contributed to the overall noise level. Traffic was grouped into one of the three categories: automobiles, medium trucks and heavy trucks, per VDOT procedure. The 20-minute traffic data was converted to one hour traffic data for validation of the noise model. The location of each noise monitoring site in relation to the project roadway is shown on the graphics located in Appendix A. The field data sheets are presented in Appendix C. The monitored Leq in the study corridor ranged from 37.0 to 72.8 dBA. Traffic noise from local streets, neighborhood activities and nature were the dominant sources of noise within the study area. The meter was calibrated before and after the measurement reading. The meter calibration certificate is included in the Appendix C.

The modeling process began with model validation, as per VDOT requirements. This was accomplished by comparing the monitored noise levels and the noise levels generated by the computer model, using traffic volumes and speeds that were encountered during the monitoring process. This validation ensures that reported changes between the existing and future design year conditions are due to changes in traffic, and not discrepancies between monitoring and modeling techniques. A difference of 3 dBA or less between the monitored and modeled levels is considered acceptable, since this is the limit of change detectable by a typical human ear.

TABLE 2: MEASURED SOUND LEVELS (DBA) AND VALIDATION

Site Location	Measured Sound Levels	Modeled Sound Levels (Validation)	Sound Level Difference	Time Period	1-hour Traffic Composition (Approximately)	
					East/North	West/South
Residence: Branders Bridge Road (MV-1)	49.8	50.7	+0.9	11:15-11:35 AM 10/3/2017	Autos-36 MT-0 HT-6	Autos-60 MT-0 HT-9
Residence: Branders Bridge Road (MV-2)	44.4	44.4	+0.0	10:20-10:40 AM 10/3/2017	Autos-57 MT-3 HT-15	Autos-60 MT-0 HT-6
Residence: Eves Lane (MV-3)	37.0	N/A	N/A	12:00-12:20 PM 10/3/2017	Autos-9 MT-0 HT-0	Autos-3 MT-0 HT-0
Residence: Harrow Drive (MV-4)	45.0	N/A	N/A	9:50-10:10 AM 10/4/2017	Autos-3 MT-0 HT-0	Autos-0 MT-0 HT-0
Residence: Treely Road (MV-5)	49.9	50.2	+0.3	12:40-1:00 PM 10/3/2017	Autos-30 MT-0 HT-0	Autos-69 MT-0 HT-0
Residence: Harrowgate Road (MV-6)	54.9	53.4	-1.5	1:30-1:50 PM 10/3/2017	Autos-210 MT-6 HT-0	Autos-231 MT-3 HT-0
Residence: Sylvania Road (MV-7)	39.3	N/A	N/A	10:45-11:05 AM 10/4/2017	Autos-3 MT-0 HT-0	Autos-0 MT-0 HT-0
Residence: Happy Hill Road (MV-8)	59.1	60.6	+1.5	11:26-11:46 AM 10/4/2017	Autos-195 MT-6 HT-3	Autos-243 MT-6 HT-6
Residence: Route 1 (MV-9)	72.8	70.2	-2.6	12:42-1:02 PM 10/4/2017	Autos-420 MT-6 HT-0	Autos-494 MT-10 HT-10

Note: short-term noise monitoring is not a process to determine design year noise impacts or barrier locations. Short-term noise monitoring provides a level of consistency between what is present in real-world situations and how that is represented in the computer noise model. Short-term monitoring does not need to occur within every CNE to validate the computer noise model.

The model validation was performed for the existing traffic conditions. However, since no 24- hour monitoring was performed to obtain the existing loudest hour, the existing noise levels obtained during the monitoring sessions were not reported as the project's existing noise levels. Instead, existing worst case hour noise levels obtained from TNM after model validation were used as the existing noise levels for the project area. The exceptions were in locations where there was zero or minimal traffic. The readings obtained during that time period were used as the existing sound levels.

A summary of the model validation was provided in Table 2. As shown for the validated sites, the difference between the modeled and monitored noise levels range from -2.6 to +1.5 dBA. The predicted levels that were modeled in the TNM differ from the recorded levels due to the complex intervening terrain features that are difficult to accurately capture. However, the validated noise levels are within the acceptable ±3 dBA. With the sites validated, the existing condition model is considered to be calibrated for the observed site conditions.

4.2 UNDEVELOPED LANDS AND PERMITTED DEVELOPMENTS

Highway traffic noise analyses are (and will be) performed for developed lands as well as undeveloped lands if they are considered "permitted." Undeveloped lands are deemed to be permitted when there is a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of at least one building permit. Please note that this is not a VDOT project. Nonetheless, in accordance with the VDOT Traffic Noise Policy, an undeveloped lot is considered to be planned, designed, and programmed if a building permit has been issued by the local authorities prior to the Date of Public Knowledge for the relevant project. VDOT considers the "Date of Public Knowledge" as the date that the final NEPA approval is made. VDOT has no obligation to provide noise mitigation for any undeveloped land that is permitted or constructed after this date.

4.3 COMMON NOISE ENVIRONMENT (CNE) DETERMINATION

For reporting purposes, the project area was divided into areas of Common Noise Environments (CNE). In accordance with VDOT guidance, noise sensitive receptors within 500 feet of the construction limits are considered as part of the evaluation. Specific CNE land uses are discussed in Section 4.5.

Existing land uses within 500 feet of the proposed improvements consist of single and multi-family residential, a hotel (pool) and a place of worship (no exterior activity). There are 11 CNE's in the project area as shown in ***Figure 2*** in Appendix A. The remaining land in the project area is primarily forested and/or undeveloped.

4.4 WORST NOISE HOUR

As required by FHWA and VDOT, the noise analysis was performed for the loudest ("worst noise") hour of the day. Noise levels have been predicted for that hour of the day when the vehicle volume, operating speed, and number of trucks (vehicles with 3 or more axles) combine to produce the worst noise conditions. According to FHWA guidance, the "worst hourly traffic noise impact" occurs at a time when truck volumes and vehicle speeds are the greatest, typically when traffic is free flowing and at or near level of service (LOS) C conditions. The worst noise hour used in this study was developed through the

City of Chesterfield and was approved by VDOT. Peak period traffic was used to represent the worst noise hour.

4.5 RECEPTOR IDENTIFICATION AND NAC CATEGORIZATION

All residential noise sensitive sites were modeled under NAC B. The Place of Worship was modeled as NAC D and the Hotel Pool was modeled as NAC E.

CNE A – North of East-West Freeway on Branders Bridge Road (Residential)

CNE A is located along Branders Bridge Road north of the East-West Freeway. CNE A consists of 3 single family residences located on Branders Bridge Road, represented by 3 noise sensitive sites (A01-A03).

Existing noise levels within CNE A are predicted to be 46-52 dBA. These receptors do not approach or exceed the NAC B criteria. The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE A.

CNE B – South of East-West Freeway on Branders Bridge Road (Residential)

CNE B is located along Branders Bridge Road south of the East-West Freeway. CNE B consists of 3 single family residences located on Branders Bridge Road, represented by 3 noise sensitive sites (B01-B03).

Existing noise levels within CNE B are predicted to be 44 dBA for all three residential sites. These receptors do not approach or exceed the NAC B criteria. The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE B.

CNE C – North of East-West Freeway on Eves Lane (Residential)

CNE C is located along Eves Lane north of the East-West Freeway. CNE C consists of 3 single family residences located on Branders Bridge Road, represented by 3 noise sensitive sites (C01-C03).

Existing noise levels within CNE C are predicted to be 37-50 dBA. These receptors do not approach or exceed the NAC B criteria. The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE C.

CNE D – North of East-West Freeway, west of Harrowgate Road (Residential)

CNE D is located north of East-West Freeway and west of Harrowgate Road. CNE D consists of 58 single family residences located on Harrowgate Road, Treely Road and Eves Lane, represented by 58 noise sensitive sites (D02-D60). Please note that based on further review, receptor D10 turned out to be an outbuilding and was deleted from the analysis. Additionally, D01 ended up being outside the 500 ft limit and was also removed from the analysis. The other receptors were not renumbered.

Existing noise levels within CNE D are predicted to be 50-58 dBA. These sites are not predicted to approach or exceed the NAC B criteria under the existing condition. The Appendix A graphic ***(Figure 2)*** shows the receptor locations in CNE D.

CNE E – South of East-West Freeway, west of Harrowgate Road (Residential)

CNE E is located south of East-West Freeway and west of Harrowgate Road. CNE E consists of 67 single family residences located on Harrowgate Road, Harrow Drive and Parkgate Drive, represented by 67 noise sensitive sites (E01-E67).

Existing noise levels within CNE E are predicted to be 45-60 dBA. These sites are not predicted to approach or exceed the NAC B criteria under the existing condition. The Appendix A graphic ***(Figure 2)*** shows the receptor locations in CNE E.

CNE F – North of East-West Freeway, east of Harrowgate Road (Residential)

CNE F is located on the northbound side of East-West Freeway and east of Harrowgate Road. There are both single-family and multi-family residential lands uses in this CNE. CNE F contains 11 single family residences located on Louise Drive, represented by 11 noise sensitive sites (F01-F11). CNE F also contains 45 multi-family residences (with outdoor first-floor patios-no balconies) located on Broadwater Way, Broadwater Court and Timsberry Terrace, represented by 4 noise sensitive sites. (F12, F13, F15 and F16). Please note that based on further review, receptors F14 and F17 were well outside the 500 foot analysis limit and were deleted from the analysis. The other receptors were not renumbered.

Existing noise levels within CNE F are predicted to range from 50 to 63 dBA. None of these noise sensitive sites have sound levels that are predicted to approach or exceed the NAC B criteria under the existing condition. The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE F.

CNE G – South of East-West Freeway, east of Harrowgate Road (Residential, Place of Worship)

CNE G is located on the south side of East-West Freeway and east of Harrowgate Road. CNE G contains 46 single family residences located on North Street, Meridian Avenue, Sylvania Road, Silvertree Lane, Silvertree Court and Happy Hill Road represented by 46 noise sensitive sites (G01-G11, G13-G47) and one place of worship (interior activity area, G12). The building is made of brick and the exterior to interior reduction factor used was 20 dBA). Some of these homes are located just outside the 500 foot maximum analysis distance from East-West Freeway, but were included in the analysis to conservatively identify all possible sound level changes.

Existing noise levels within CNE G are predicted to range from 40 to 65 dBA. None of these noise sensitive sites have sound levels that are predicted to approach or exceed the NAC B or D criteria under the existing condition. The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE G.

CNE H – North of East-West Freeway, west of Happy Hill Road (Residential)

CNE H is located on the north side of East-West Freeway and west of Happy Hill Road. CNE H contains 12 single family residences located on Happy Hill Road and Marobrith Drive, represented by 12 noise sensitive sites (H01-H12). Some of these homes are located just outside the 500 foot maximum analysis distance from East-West Freeway, but were included in the analysis to conservatively identify all possible sound level changes.

Existing noise levels within CNE H are predicted to range from 50 to 59 dBA. None of these noise sensitive sites have sound levels that are predicted to approach or exceed the NAC B criteria under the existing condition. The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE H.

CNE I – North of East-West Freeway, west of US 1 (Residential)

CNE I (Colonial Ridge) is located on the north side of East-West Freeway and west of US 1. CNE I contains one single family receptor (I01) on Happy Hill Road and 48 multi-family family residences located in Colonial Ridge, represented by 4 noise sensitive sites (I03-I06). Please note that based on further review, receptor I02 was well outside the 500 foot analysis limit and were deleted from the analysis. The other receptors were not renumbered.

Existing noise levels within CNE C are predicted to range from 50 to 62 dBA. None of these noise sensitive sites have sound levels that are predicted to approach or exceed the NAC B criteria under the existing condition. The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE IC.

CNE J – Southbound Side of I-64 (Residential)

CNE J is located on the south side of East-West Freeway and east of Happy Hill Road. CNE J contains 4 single family residences, represented by 4 noise sensitive sites (J01-J04).

Existing noise levels within CNE J are predicted to range from 62 to 65 dBA. None of these noise sensitive sites have sound levels that are predicted to approach or exceed the NAC B criteria under the existing condition. The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE J.

CNE K – South Side of East-West Freeway, west of I-95 (Hotel)

CNE K (Econo Lodge) is located on the southbound side of East-West Freeway and west of I-95. This outdoor hotel pool is the only receptor in CNE K.

Existing noise levels within CNE K are predicted to be 54 dBA. The noise sensitive site does not have sound levels that are predicted to approach or exceed the NAC E criteria under the existing condition. The The Appendix A graphic ***(Figure 2)*** shows all of the receptor locations in CNE K.

4.6 MODELED EXISTING ENVIRONMENT

There are zero (0) noise sensitive receptors that are predicted to be impacted by traffic noise under the existing condition due to levels approaching or exceeding the NAC as shown in Table 3. For all studied sites, the existing year noise levels range from 40 to 65 dBA. Figure 2 in Appendix A shows the location of the CNE's. The Appendix A graphic ***(Figure 2)*** shows all of the modeled receptor locations by CNE.

5. FUTURE NOISE ENVIRONMENT

Noise levels in the study area were predicted for the future design year (2042) build conditions using the TNM computer model. Design year no-build noise levels are not required for this traffic noise study because the project is not related to the interstate system, as stated in the VDOT State Noise Abatement Policy. Assessment of traffic noise impact requires these comparisons:

1) The noise levels under existing conditions must be compared to those under design year build conditions. This comparison shows the change in noise levels that will occur between the existing year and the design year if the project is constructed, to determine if the substantial increase impact criteria has been met.
2) The noise levels under design year build conditions must be compared to the applicable NAC. This comparison determines if the impact criteria has been met under future build conditions and can be used to assist in noise compatible land use planning.

Noise impacts are predicted under the design year build condition (2042) due to noise levels approaching or exceeding the NAC and/or meeting the substantial increase criteria as shown in Table 3. Calculated noise levels for all noise sensitive sites and conditions are listed in Table 3. Descriptions of each CNE are included in ***Section 4.3.***

5.1 MODELED FUTURE 2042 NO-BUILD ALTERNATIVE

The no-build alternative was not analyzed because this project is not related to the interstate system.

5.2 MODELED FUTURE 2042 BUILD ALTERNATIVE

Ninety-one noise sensitive sites, represented by 90 residences and one Place of Worship are predicted to be impacted by traffic noise under the design year build (2042) noise levels. Noise levels are predicted to range from 50 to 68 dBA. A detailed display of the modeling results are shown in ***Figure 2 (Index sheet and Pages 1-6)*** in Appendix A.

CNE A – North of East-West Freeway on Branders Bridge Road (Residential)

Design year build noise levels within CNE A are predicted to range from 56 to 61 dBA. The sound levels meet the substantial increase criteria for one receptor. Mitigation consideration is warranted.

CNE B – South of East-West Freeway on Branders Bridge Road (Residential)

Design year build noise levels within CNE B are predicted to range from 51 to 55 dBA. The sound levels meet the substantial increase criteria for one receptor. Mitigation consideration is warranted.

CNE C – North of East-West Freeway on Eves Lane (Residential)

Design year build noise levels within CNE B are predicted to range from 51 to 57 dBA. The sound levels meet the substantial increase criteria for two receptors. Mitigation consideration is warranted.

CNE D – North of East-West Freeway, west of Harrowgate Road (Residential)

Design year build noise levels within CNE D are predicted to range from 50 to 64 dBA. The sound levels meet the substantial increase criteria for three receptors. Mitigation consideration is warranted.

CNE E – South of East-West Freeway, west of Harrowgate Road (Residential)

Design year build noise levels within CNE E are predicted to range from 53 to 66 dBA. The sound levels meet the NAC or substantial increase criteria for 43 receptors. Mitigation consideration is warranted.

CNE F – North of East-West Freeway, east of Harrowgate Road (Residential)

Design year build noise levels within CNE F are predicted to range from 50 to 64 dBA. The sound levels meet the substantial increase criteria for four receptors. Mitigation consideration is warranted.

CNE G – South of East-West Freeway, east of Harrowgate Road (Residential, Place of Worship)

Design year build noise levels within CNE G are predicted to range from 48 to 67 dBA. The sound levels meet the NAC or substantial increase criteria for 34 receptors. Mitigation consideration is warranted.

CNE H – North of East-West Freeway, west of Happy Hill Road (Residential)

Design year build noise levels within CNE H are predicted to range from 52 to 64 dBA. The sound levels do not meet the NAC criteria. Mitigation consideration is not recommended.

CNE I – North of East-West Freeway, west of US 1 (Residential)

Design year build noise levels within CNE I are predicted to range from 50 to 63 dBA. The sound levels do not meet the NAC criteria. Mitigation consideration is not recommended.

CNE J – Southbound Side of East-West Freeway (Residential)

Design year build noise levels within CNE J are predicted to range from 64 to 68 dBA. The sound levels meet the NAC criteria for three receptors. Mitigation consideration is warranted.

CNE K – South Side of East-West Freeway, west of I-95 (Hotel Pool)

Design year build noise levels within CNE K are predicted to be 61 dBA. The sound levels do not meet the NAC criteria. Mitigation consideration is not recommended.

Railroad Noise Effects

Rail noise was also addressed in the analysis. At this time, however, the rail line is fairly conceptual and preliminary, particularly since its present location is outside the current proposed highway right-of-way, the cut/fill lines have not yet been developed and the conceptual centerline runs through the proposed East-West Freeway/Harrowgate interchange. Furthermore, the genuine need for the rail line has not yet been established since it will be dependent on development that may or may not take place west of Branders Bridge Road. Nonetheless, a qualitative analysis is being presented so as to be cognizant of the potential impacts and mitigation concerns, as generalized as they may be at this time. Please note that no mitigation commitments will be made at this time due to the conceptual nature of the alignment though mitigation will be generally discussed in ***Section 6.5***.

Table 3 shows the possible dBA changes that may occur if the rail line is built. The assumptions made for the analysis included two trains per day (one at night), each with approximately 72 cars (5760 ft. long) and two locomotives per train. The train was also predicted to be traveling at 10 mph. Worst case rail noise levels were calculated using FRA's CREATE model and logarithmically added to the results from the TNM noise model. Generally, the added train noise did not add much (if any) dBA to the total Leqs.

TABLE 3: PREDICTED NOISE LEVELS

Receptor Number	Land Use	Number of Dwelling Units	Existing dBA Leq	Year 2042 Build dBA Leq	Rail dBA Leq Added	Noise Abatement Criteria dBA Leq	Abatement Warranted?
CNE A							
A01	Residential	1	46	61	R-O-W	56	Yes
A02	Residential	1	51	57	57	61	No
A03	Residential	1	52	56	56	62	No
CNE B							
B01	Residential	1	44	55	55	55	Yes
B02	Residential	1	44	52	52	55	No
B03	Residential	1	44	51	51	55	No
CNE C							
C01	Residential	1	37	57	57	47	Yes
C02	Residential	1	37	57	57	47	Yes
C03	Residential	1	50	51	52	60	No

XX	Indicates Noise Impact (NAC)
XX	Indicates Noise Impact (Substantial Increase)
R-O-W	Possible Right-Of-Way Acquisition

Receptor Number	Land Use	Number of Dwelling Units	Existing dBA Leq	Year 2042 Build dBA Leq	Rail dBA Leq Added	Noise Abatement Criteria dBA Leq	Abatement Warranted?
CNE D							
D02	Residential	1	50	50	50	60	No
D03	Residential	1	50	50	50	60	No
D04	Residential	1	50	50	50	60	No
D05	Residential	1	50	50	50	60	No
D06	Residential	1	50	50	50	60	No
D07	Residential	1	50	50	50	60	No
D08	Residential	1	50	50	50	60	No
D09	Residential	1	50	50	50	60	No
D11	Residential	1	50	50	50	60	No
D12	Residential	1	50	53	53	60	No
D13	Residential	1	50	51	51	60	No
D14	Residential	1	50	52	52	60	No
D15	Residential	1	50	52	52	60	No
D16	Residential	1	50	53	53	60	No
D17	Residential	1	50	53	53	60	No
D18	Residential	1	50	54	54	60	No
D19	Residential	1	50	54	54	60	No
D20	Residential	1	50	56	56	60	No
D21	Residential	1	50	56	56	60	No
D22	Residential	1	50	56	56	60	No
D23	Residential	1	50	57	57	60	No
D24	Residential	1	50	58	58	60	No
D25	Residential	1	50	58	58	60	No
D26	Residential	1	50	58	58	60	No
D27	Residential	1	50	59	59	60	No
D28	Residential	1	50	61	61	60	Yes
D29	Residential	1	50	62	62	60	Yes
D30	Residential	1	51	64	R-O-W	61	Yes
D31	Residential	1	56	62	62	66	No
D32	Residential	1	58	62	62	66	No
D33	Residential	1	50	57	57	60	No
D34	Residential	1	50	56	56	60	No
D35	Residential	1	50	55	55	60	No
D36	Residential	1	50	54	54	60	No
D37	Residential	1	50	54	54	60	No
D38	Residential	1	50	54	54	60	No
D39	Residential	1	50	54	54	60	No
D40	Residential	1	50	53	53	60	No
D41	Residential	1	50	53	53	60	No
D42	Residential	1	50	53	53	60	No

D43	Residential	1	50	53	53	60	No
D44	Residential	1	50	52	52	60	No
D45	Residential	1	50	52	52	60	No
D46	Residential	1	50	52	52	60	No
D47	Residential	1	50	51	51	60	No
D48	Residential	1	50	51	51	60	No
D49	Residential	1	50	51	51	60	No
D50	Residential	1	50	50	50	60	No
D51	Residential	1	50	50	50	60	No
D52	Residential	1	50	50	50	60	No
D53	Residential	1	56	59	59	66	No
D54	Residential	1	51	56	56	61	No
D55	Residential	1	51	56	56	61	No
D56	Residential	1	52	56	56	62	No
D57	Residential	1	52	56	56	62	No
D58	Residential	1	50	50	50	60	No
D59	Residential	1	50	52	52	60	No
D60	Residential	1	50	52	52	60	No

XX	Indicates Noise Impact (NAC)
XX	Indicates Noise Impact (Substantial Increase)
R-O-W	Possible Right-Of-Way Acquisition

Receptor Number	Land Use	Number of Dwelling Units	Existing dBA Leq	Year 2042 Build dBA Leq	Rail dBA Leq Added	Noise Abatement Criteria dBA Leq	Abatement Warranted?
CNE E							
E01	Residential	1	45	66	66	55	Yes
E02	Residential	1	45	66	66	55	Yes
E03	Residential	1	45	61	61	55	Yes
E04	Residential	1	45	60	60	55	Yes
E05	Residential	1	45	58	58	55	Yes
E06	Residential	1	45	58	58	55	Yes
E07	Residential	1	45	58	58	55	Yes
E08	Residential	1	45	58	58	55	Yes
E09	Residential	1	45	58	58	55	Yes
E10	Residential	1	45	54	54	55	No
E11	Residential	1	45	55	55	55	Yes
E12	Residential	1	45	54	54	55	No
E13	Residential	1	45	54	54	55	No
E14	Residential	1	45	54	54	55	No
E15	Residential	1	45	54	54	55	No
E16	Residential	1	45	56	56	55	Yes
E17	Residential	1	45	56	56	55	Yes
E18	Residential	1	45	56	56	55	Yes
E19	Residential	1	45	55	55	55	Yes
E20	Residential	1	45	56	56	55	Yes
E21	Residential	1	45	56	56	55	Yes
E22	Residential	1	45	57	57	55	Yes
E23	Residential	1	45	58	58	55	Yes
E24	Residential	1	45	59	59	55	Yes
E25	Residential	1	45	59	59	55	Yes
E26	Residential	1	45	60	60	55	Yes
E27	Residential	1	45	60	60	55	Yes
E28	Residential	1	45	61	61	55	Yes
E29	Residential	1	45	60	60	55	Yes
E30	Residential	1	45	59	59	55	Yes
E31	Residential	1	45	57	57	55	Yes
E32	Residential	1	45	56	56	55	Yes
E33	Residential	1	45	56	56	55	Yes
E34	Residential	1	45	56	56	55	Yes
E35	Residential	1	45	56	56	55	Yes
E36	Residential	1	45	57	57	55	Yes
E37	Residential	1	46	57	57	56	Yes
E38	Residential	1	48	57	57	58	No
E39	Residential	1	50	58	58	60	No
E40	Residential	1	60	66	66	66	Yes

E41	Residential	1	60	65	65	66	No
E42	Residential	1	58	63	63	66	No
E43	Residential	1	60	65	65	66	No
E44	Residential	1	54	59	59	64	No
E45	Residential	1	49	56	56	59	No
E46	Residential	1	47	55	55	57	No
E47	Residential	1	46	55	55	56	No
E48	Residential	1	45	56	56	55	Yes
E49	Residential	1	45	55	55	55	Yes
E50	Residential	1	45	54	54	55	No
E51	Residential	1	45	55	55	55	Yes
E52	Residential	1	45	56	56	55	Yes
E53	Residential	1	45	56	56	55	Yes
E54	Residential	1	45	56	56	55	Yes
E55	Residential	1	45	57	57	55	Yes
E56	Residential	1	45	57	57	55	Yes
E57	Residential	1	45	56	56	55	Yes
E58	Residential	1	45	55	55	55	Yes
E59	Residential	1	45	54	54	55	No
E60	Residential	1	45	53	53	55	No
E61	Residential	1	45	53	53	55	No
E62	Residential	1	45	54	54	55	No
E63	Residential	1	45	54	54	55	No
E64	Residential	1	45	53	53	55	No
E65	Residential	1	45	54	54	55	No
E66	Residential	1	45	54	54	55	No
E67	Residential	1	46	53	53	55	No

XX	Indicates Noise Impact (NAC)
XX	Indicates Noise Impact (Substantial Increase)
R-O-W	Possible Right-Of-Way Acquisition

Receptor Number	Land Use	Number of Dwelling Units	Existing dBA Leq	Year 2042 Build dBA Leq	Rail dBA Leq Added	Noise Abatement Criteria dBA Leq	Abatement Warranted?
CNE F							
F01	Residential	1	54	64	64	64	Yes
F02	Residential	1	50	61	61	60	Yes
F03	Residential	1	50	60	61	60	Yes
F04	Residential	1	50	61	61	60	Yes
F05	Residential	1	50	56	56	60	No
F06	Residential	1	50	56	56	60	No
F07	Residential	1	50	55	55	60	No
F08	Residential	1	50	54	54	60	No
F09	Residential	1	50	53	53	60	No
F10	Residential	1	50	52	52	60	No
F11	Residential	1	63	64	64	66	No
F12	Residential-Multi Family	10	52	54	54	62	No
F13	Residential-Multi Family	8	50	50	50	60	No
F15	Residential-Multi Family	8	55	56	56	65	No
F16	Residential-Multi Family	19	56	56	56	66	No
XX	Indicates Noise Impact (NAC)						
XX	Indicates Noise Impact (Substantial Increase)						
R-O-W	Possible Right-Of-Way Acquisition						

Receptor Number	Land Use	Number of Dwelling Units	Existing dBA Leq	Year 2042 Build dBA Leq	Rail dBA Leq Added	Noise Abatement Criteria dBA Leq	Abatement Warranted?
CNE G							
G01	Residential	1	51	R-O-W	R-O-W	-	-
G02	Residential	1	62	65	65	66	No
G03	Residential	1	57	60	60	66	No
G04	Residential	1	53	57	57	63	No
G05	Residential	1	50	56	56	60	No
G06	Residential	1	48	54	54	58	No
G07	Residential	1	45	53	53	55	No
G08	Residential	1	45	55	55	55	Yes
G09	Residential	1	44	51	51	54	No
G10	Residential	1	43	52	52	53	No
G11	Residential	1	42	52	52	52	Yes
G12	Place of Worship (interior)	0	23	37	37	33	Yes
G13	Residential	1	41	48	48	51	No
G14	Residential	1	44	52	52	54	No
G15	Residential	1	40	51	51	50	Yes
G16	Residential	1	42	58	58	52	Yes
G17	Residential	1	40	54	54	50	Yes
G18	Residential	1	40	51	51	50	Yes
G19	Residential	1	40	54	54	50	Yes
G20	Residential	1	40	51	51	50	Yes
G21	Residential	1	40	52	52	50	Yes
G22	Residential	1	40	56	56	50	Yes
G23	Residential	1	40	53	53	50	Yes
G24	Residential	1	40	60	60	50	Yes
G25	Residential	1	40	54	54	50	Yes
G26	Residential	1	40	55	55	50	Yes
G27	Residential	1	40	56	56	50	Yes
G28	Residential	1	40	59	59	50	Yes
G29	Residential	1	40	60	60	50	Yes
G30	Residential	1	40	56	56	50	Yes
G31	Residential	1	40	61	61	50	Yes
G32	Residential	1	40	56	56	50	Yes
G33	Residential	1	40	61	61	50	Yes
G34	Residential	1	40	56	56	50	Yes
G35	Residential	1	40	61	61	50	Yes
G36	Residential	1	40	56	56	50	Yes
G37	Residential	1	40	60	60	50	Yes
G38	Residential	1	40	56	56	50	Yes
G39	Residential	1	40	60	60	50	Yes
G40	Residential	1	40	56	56	50	Yes
G41	Residential	1	40	55	55	50	Yes

G42	Residential	1	40	55	55	50	Yes
G43	Residential	1	40	56	56	50	Yes
G44	Residential	1	62	64	64	66	No
G45	Residential	1	64	66	66	66	Yes
G46	Residential	1	65	67	67	66	Yes
G47	Residential	1	63	64	64	66	No

XX	Indicates Noise Impact (NAC)
XX	Indicates Noise Impact (Substantial Increase)
R-O-W	Possible Right-Of-Way Acquisition

Receptor Number	Land Use	Number of Dwelling Units	Existing dBA Leq	Year 2042 Build dBA Leq	Rail dBA Leq Added	Noise Abatement Criteria dBA Leq	Abatement Warranted?
CNE H							
H01	Residential	1	50	52	52	60	No
H02	Residential	1	50	53	53	60	No
H03	Residential	1	50	53	53	60	No
H04	Residential	1	50	53	53	60	No
H05	Residential	1	50	54	54	60	No
H06	Residential	1	50	55	55	60	No
H07	Residential	1	50	55	55	60	No
H08	Residential	1	50	55	55	60	No
H09	Residential	1	50	55	55	60	No
H10	Residential	1	55	60	60	65	No
H11	Residential	1	59	64	64	64	No
H12	Residential	1	55	55	55	65	No
CNE I							
I01	Residential	1	62	63	63	66	No
I03	Residential	12	50	53	53	60	No
I04	Residential	12	50	54	54	60	No
I05	Residential	12	50	53	53	60	No
I06	Residential	12	50	50	50	60	No
CNE J							
J01	Residential	1	64	68	R-O-W	66	Yes
J02	Residential	1	64	66	66	66	Yes
J03	Residential	1	62	64	64	66	No
J04	Residential	1	65	67	67	66	Yes
CNE K							
K01	Motel Pool	1	54	61	61	64	No
Number of Noise Impacts (total all CNE's)							
-			0	91		-	
Noise Level Ranges (all CNE's)							
Minimum (Exterior dBA)			40	50		-	
Maximum (Exterior dBA)			65	68		-	

XX	Indicates Noise Impact (NAC)
XX	Indicates Noise Impact (Substantial Increase)
R-O-W	Possible Right-Of-Way Acquisition

6. NOISE ABATEMENT DETERMINATION

Noise Abatement Determination is a three-phased approach. The first phase of the process is to determine if highway traffic noise abatement consideration is warranted for the affected communities and/or affected receptors. The warranted criterion specifically pertains to traffic noise impacted receptors, defined back in ***Section 3.3.*** Since predicted noise levels for the future design year build (2042) condition either approach or exceed the NAC, and/or meet the substantial increase criterion, therefore per VDOT's State Noise Abatement Policy, noise abatement considerations are warranted for these impacted noise sensitive areas. Determining that noise abatement is warranted is the first phase (Phase 1) of the three-phased noise abatement criteria. Phases 2 and 3 address the feasibility and reasonableness, respectively, of the noise abatement measures being considered, which are discussed in ***Sections 6.2 and 6.3.*** Following the completion of all three phases, a determination can be made regarding the feasibility and reasonableness of the noise abatement options.

6.1 ABATEMENT MEASURES EVALUATION

VDOT guidelines recommend a variety of mitigation measures that should be considered in response to transportation-related noise impacts. While noise barriers and/or earth berms are generally the most effective form of noise mitigation, additional mitigation measures exist which have the potential to provide considerable noise reductions, under certain circumstances. Mitigation measures considered for this project include:

- Traffic Management
- Alignment Modifications
- Acoustical Insulation of Public-Use and Non-Profit Facilities
- Buffer Lands
- Construction of Earth Berms;
- Construction of Noise Barriers;

Additionally, the Noise Policy Code of Virginia (HB 2577, as amended by HB 2025) states: Requires that whenever the Commonwealth Transportation Board or the Department plan for or undertake any highway construction or improvement project and such project includes or may include the requirement for the mitigation of traffic noise impacts, first consideration should be given to the use of noise reducing design and low noise pavement materials and techniques in lieu of construction of noise walls or sound barriers. Vegetative screening, such as the planting of appropriate conifers, in such a design would be utilized to act as a visual screen if visual screening is required. Consideration will be given to these measures during the final design stage, where feasible. The response from project management is included in Appendix E.

Traffic Management (TM): Traffic management measures, such as speed limit restrictions, truck traffic restrictions, and other traffic control measures that may be considered for the reduction of noise emission levels are not practical for this project. Reducing speeds will not be an effective noise mitigation measure since a substantial decrease in speed is necessary to provide adequate noise reduction. Typically, a 10 mph reduction in speed will result in only a 2 dBA decrease in noise level, which would not eliminate all impacts. Additionally, a reduction in speed is not practical for this grade-separated arterial since the posted speed is only 55 miles per hour and would be difficult to enforce.

Alignment Modifications: The alignment was chosen from a group of alignments as a combination of being the least disruptive and most efficient. The alteration of the horizontal and vertical alignment has been considered to reduce or eliminate the impacts created by the proposed project. Shifting the horizontal alignment to the outside or inside will create undesirable impacts such as right-of-way acquisition, temporary/permanent easements and possibly, retaining walls. Shifting the roadway alignment away from the impacted residences will increase impacts to other residences located on the opposite side of the interstate. Vertical alignment shifts would affect the various underpasses, overpasses and grade separated interchanges in the project area.

Acoustical Insulation of Public-Use and Non-Profit Facilities: This noise abatement measure option applies only to public and institutional use buildings. Since no public use or institutional structures are anticipated to have interior noise levels exceeding FHWA's interior NAC, this noise abatement option will not be applied.

Buffer Lands: The purchase of property for noise barrier construction or the creation of a "buffer zone" to reduce noise impacts is only considered for predominantly unimproved properties because the amount of property required for this option to be effective would create significant additional impacts (e.g., in terms of residential displacements), which were determined to outweigh the benefits of land acquisition.

Construction of Berms / Noise Barriers: Construction of noise barriers can be an effective way to reduce noise levels at areas of outdoor activity. Noise barriers can be wall structures, earthen berms, or a combination of the two. The effectiveness of a noise barrier depends on the distance and elevation difference between roadway and receptor and the available placement location for a barrier. Gaps between overlapping noise barriers also decrease the effectiveness of the barrier, as opposed to a single connected barrier. The barrier's ability to attenuate noise decreases as the gap width increases.

Noise walls and earth berms are often implemented into the highway design in response to the identified noise impacts. The effectiveness of a freestanding (post and panel) noise barrier and an earth berm of equivalent height are relatively consistent; however an earth berm is perceived as a more aesthetically pleasing option. The use of earth berms is not always an option due to the excessive space they require adjacent to the roadway corridor. At a standard slope of 2:1, every one-foot in height would require four feet of horizontal width. This requirement becomes more complex in urban settings where residential properties often about the proposed roadway corridor. In these situations, implementation of earth berms can require significant property acquisitions to accommodate noise mitigation. The cost associated with the acquisition of property to construct a berm can significantly increase the total costs to implement this form of noise mitigation.

Availability of fill material to construct the berm also needs to be considered. On proposed projects where proposed grading yields excess waste material, earth berms are often cost effective mitigation options. On balance or borrow projects the implementation of earth berms is often an expensive solution due to the need to identify, acquire, and transport the material to the project site. Earth berms may be considered a viable mitigation option throughout the project area, and would be evaluated further where possible in the final design stage.

As a general practice, noise barriers are most effective when placed at a relatively high point between the roadway and the impacted noise sensitive land use. To achieve the greatest benefit from a potential noise

barrier, the goal of the barrier should focus on breaking the line-of-sight (to the greatest degree possible) from the roadway to the receptor. In roadway fill conditions, where the highway is above the natural grade, noise barriers are typically most effective when placed on the edge of the roadway shoulder or on top of the fill slope. In roadway cut conditions, where the roadway is located below the natural grade, barriers are typically most effective when placed at the top of the cut slope. Engineering and safety issues have the potential to alter these typical barrier locations.

The effectiveness of a noise barrier is measured by examining the barrier's capability to reduce future noise levels. Noise reduction is measured by comparing design year pre- and post-barrier noise levels. This difference between unabated and abated noise levels is known as insertion loss (IL). The following discussion presents potential mitigation measures for each of the impacted noise sensitive land uses.

According to VDOT guidelines, potential mitigation measures for warranted receptors must also be assessed for feasibility and reasonableness.

6.2 FEASIBILITY CRITERION FOR NOISE BARRIERS

All receptors that meet the warranted criterion must progress to the "feasible" phase. Phase 2 of the noise abatement criteria requires that both of the following acoustical and engineering conditions be considered.

- At least a 5 dB(A) highway traffic noise reduction at impacted receptors. Per 23 CFR 772 FHWA requires the highway agency to determine the number of impacted receptors required to achieve at least 5 dB(A) of reduction. VDOT requires that fifty percent (50%) or more of the impacted receptors experience 5 dB(A) or more of insertion loss to be feasible; and;
- The determination that it is possible to design and construct the noise abatement measure. The factors related to the design and construction include: safety, barrier height, topography, drainage, utilities, and maintenance of the abatement measure, maintenance access to adjacent properties, and general access to adjacent properties (i.e. arterial widening projects).

The noise abatement measure is said to be feasible if it meets both criteria.

6.3 REASONABLENESS CRITERION FOR NOISE BARRIERS

All receptors that meet the feasibility criterion must progress to the "reasonableness" phase. Phase 3 of the noise abatement criteria requires that all of the following conditions be considered.

- Noise Reduction Design Goals

The design goal is a reasonableness factor indicating a specific reduction in noise levels that VDOT uses to identify that a noise abatement measure effectively reduces noise. The design goal establishes a criterion, selected by VDOT, which noise abatement must achieve. VDOT's noise reduction design goal is defined as a 7 dB(A) of insertion loss for at least one impacted receptor. The design goal is not the same as acoustic feasibility, which defines the minimum level of effectiveness for a noise abatement measure. Acoustic feasibility indicates that the noise abatement measure can, at a minimum, achieve a discernible reduction in noise levels. Noise reduction is measured by comparing the future design year build condition pre-and post-barrier noise levels. This difference between unabated and abated noise levels is known as "insertion loss" (IL). It is important to optimize the noise barrier design to achieve the

most effective noise barrier in terms of both noise reduction (insertion losses) and cost. Although at least a 5 dB(A) reduction is required to meet the feasibility criteria, the following tiered noise barrier abatement goals should be used to govern barrier design and optimization.

- Reduction of future highway traffic noise by 7 dB(A) at one (1) or more of the impacted receptor sites (required criterion).
- Reduction of future highway traffic noise levels to the low-60-decibel range when practical (desirable).
- Reduction of future highway traffic noise levels to existing noise levels when practical (desirable).

- Cost Effectiveness

Typically, the limiting factor related to barrier reasonableness is the cost effectiveness value, where the total surface area of the barrier is divided by the number of benefited receptors receiving at least a 5 dBA reduction in noise level. VDOT's approved cost is based on a maximum square footage of abatement per benefited receptor, a value of 1,600 square feet per benefited receptor.

Where multi-family housing includes balconies at elevations that exceed a 30-ft high barrier or the topography causes receptors to be above the elevation of a 30-ft barrier, these receptors are not assessed for barrier benefits and are not included in the computation of the barrier's reasonableness.

For non-residential properties such as parks and public use facilities, a special calculation is performed in order to quantify the type and duration of activity and compare to the cost effectiveness criterion. The determination is based on cost, severity of impact (both in terms of noise levels and the size of the impacted area and the activity it contains), and amount of noise reduction.

- The Viewpoints of the Benefited Receptors

The client shall solicit the viewpoints of all benefited receptors through certified mailings and obtain enough responses to document a decision as to whether or not there is a desire for the proposed noise abatement measure. Fifty percent (50%) or more of the respondents shall be required to favor the noise abatement measure in determining reasonableness. Community views in and of themselves are not sufficient for a barrier to be found reasonable if one or both of the other two reasonableness criteria are not satisfied.

6.4 NOISE BARRIER ABATEMENT EVALUATION SUMMARY

Noise barriers were evaluated in all areas predicted to be impacted by traffic noise in the build condition. There were no barriers that were found to be both feasible and reasonable. Barrier A was evaluated for the future design year noise impacts in CNE A, Barrier B for CNE B, Barrier C for CNE C, Barrier D & F for abutting CNEs D & F, Barrier E & G for abutting CNE's E & G and Barrier J for CNE J. These evaluated barriers were not found to be both feasible and reasonable in accordance with VDOT's State Noise Abatement Policy. The analyzed barrier locations are shown on the graphics located in Appendix A. The Warranted, Feasible, and Reasonable Worksheets were completed for all the barrier analysis areas and are included in Appendix D.

Mitigation for rail noise was also addressed in the analysis (as applicable) and is discussed after the highway mitigation analysis in this section.

Barrier A

The land uses in CNE A are residential. The ground-mounted barrier was located near the East-West Freeway mainline to maximize its effectiveness. Tables 4 and 5 show the insertion loss summary and the barrier parameters.

Barrier A has panel heights ranging approximately 14 to 20 feet and a total length of 1,098 feet, resulting in a surface area of approximately 18,892 square feet, based on the vertical profile utilizing TNM, current roadway plans and current cut/fill lines. The barrier would benefit one out of one impacted sites (100%). This results in a ratio of 18,892 square feet per benefited receptor. This barrier is not considered both feasible and reasonable in accordance with VDOT's State Noise Abatement Policy and is not recommended for construction.

TABLE 4: BARRIER A INSERTION LOSS SUMMARY

Receptor ID Number	Number of Dwelling Units	Predicted Future Design Build Noise Levels (No Barrier) (dBA)	Predicted Future Design Build Noise Levels (With Barrier) (dBA)	Insertion Loss (IL)* (dBA)
A01	1	61	54	7
A02	1	57	56	1
A03	1	56	55	0
X	Indicates noise impact (Substantial Increase)			
X	Indicates at least a 5dB benefit			

*Values are rounded off and may not reflect typical subtraction results.

TABLE 5: EVALUATED NOISE BARRIER PARAMETERS

Barrier	Insertion Loss (IL)	Height (Range) (ft)	Total Length (ft)	Total Area (ft^2)	Benefitted	Area/ Benefitted	Cost ($48/$ft^2$)
A	0-7	14-20	1,098	18,892	1 (100%)	18,892	$906,816

Barrier B

The land uses in CNE B are residential. The ground-mounted barrier was located near the East-West Freeway mainline to maximize its effectiveness. Tables 6 and 7 show the insertion loss summary and the barrier parameters.

Barrier B has maximum VDOT panel heights of 30 feet and a total length of 2,101 feet, resulting in a surface area of approximately 63,026 square feet, based on the vertical profile utilizing TNM, current roadway plans and current cut/fill lines. The barrier would benefit one out of one impacted sites (100%) plus one non-impacted receptor. This results in a ratio of 31,513 square feet per benefited receptor. The barrier also does not meet the 7 dBA design goal and is not considered both feasible and reasonable in accordance with VDOT's State Noise Abatement Policy and is not recommended for construction.

TABLE 6: BARRIER B INSERTION LOSS SUMMARY

Receptor ID Number	Number of Dwelling Units*	Predicted Future Design Build Noise Levels (No Barrier) (dBA)	Predicted Future Design Build Noise Levels (With Barrier) (dBA)	Insertion Loss (IL)** (dBA)
B01	1	55	49	6
B02	1	52	46	6
B03	1	50	46	4
X	Indicates noise impact (Substantial Increase)			
X	Indicates at least a 5dB benefit.			

*Values are rounded off and may not reflect typical subtraction results.

TABLE 7: EVALUATED NOISE BARRIER PARAMETERS

Barrier	Insertion Loss (IL)	Height (Range) (ft)	Total Length (ft)	Total Area (ft^2)	Benefitted	Area/ Benefitted	Cost ($48/$ft^2$)
B	4-6	30	2,101	63,026	2 (100%)	31,513	$3,025,248

Barrier C

The land uses in CNE C are residential. The ground-mounted barrier was located near the East-West Freeway mainline with some transitioning to the right-of-way line to maximize its effectiveness. Tables 8 and 9 show the insertion loss summary and the barrier parameters.

Barrier C has panel heights ranging approximately 18 to 24 feet and a total length of 1,939 feet, resulting in a surface area of approximately 45,265 square feet, based on the vertical profile utilizing TNM, current roadway plans and current cut/fill lines. The barrier would benefit two out of two impacted sites (100%), plus one non-impacted receptor. This results in a ratio of 15,088 square feet per benefited receptor. This barrier is not considered both feasible and reasonable in accordance with VDOT's State Noise Abatement Policy and is not recommended for construction.

TABLE 8: BARRIER C INSERTION LOSS SUMMARY

Receptor ID Number	Number of Dwelling Units*	Predicted Future Design Build Noise Levels (No Barrier) (dBA)	Predicted Future Design Build Noise Levels (With Barrier) (dBA)	Insertion Loss (IL)** (dBA)
C01	1	57	50	7
C02	1	57	50	7
C03	1	51	46	5
X	Indicates noise impact (Substantial Increase)			
X	Indicates at least a 5dB benefit.			

*Values are rounded off and may not reflect typical subtraction results.

TABLE 9: EVALUATED NOISE BARRIER PARAMETERS

Barrier	Insertion Loss (IL)	Height (Range) (ft)	Total Length (ft)	Total Area (ft^2)	Benefitted	Area/ Benefitted	Cost ($48/$ft^2$)
C	5-7	18-24	1,939	45,265	3 (100%)	15,088	$2,172,720

Barrier D & F

The land uses in CNE D and F are residential. If barriers were to be modeled separately for these CNEs, then they would likely overlap into each other's area. Therefore, a set of three overlapping barriers were modeled to analyze mitigation for CNE D and F. The ground-mounted barrier was located near the East-West Freeway mainline with some transitioning to the right-of-way line to maximize its effectiveness. A structure mounted barrier was also analyzed over Harrowgate Road. Tables 10 and 11 show the insertion loss summary and the barrier parameters.

This barrier set has panel heights ranging approximately 13 to 22 feet and a total length of 3,220 feet, resulting in a surface area of approximately 59,747 square feet, based on the vertical profile utilizing TNM, current roadway plans and current cut/fill lines. The barrier would benefit five out of seven impacted sites (71%), plus eleven non-impacted receptors. This results in a ratio of 3,734 square feet per benefited receptor. This barrier is not considered both feasible and reasonable in accordance with VDOT's State Noise Abatement Policy and is not recommended for construction.

TABLE 10: BARRIER D & F INSERTION LOSS SUMMARY

Impacted Receptor ID Number	Number of Dwelling Units*	Predicted Future Design Build Noise Levels (No Barrier) (dBA)	Predicted Future Design Build Noise Levels (With Barrier) (dBA)	Insertion Loss (IL)** (dBA)
D20	1	56	53	3
D21	1	56	52	4
D22	1	56	52	**5**
D23	1	57	52	**5**
D24	1	58	52	**5**
D25	1	58	53	**5**
D26	1	58	52	**6**
D27	1	59	53	**6**
D28	1	61	54	**7**
D29	1	62	55	**7**
D30	1	64	60	3
D31	1	62	60	2
D32	1	62	62	1
D33	1	57	54	3
D34	1	56	53	3
D35	1	55	51	**5**
D36	1	54	50	**5**
D37	1	54	51	3
D38	1	54	50	4
D39	1	54	50	3
D40	1	53	50	3
D41	1	53	51	2

D53	1	59	58	1
F01	1	64	60	3
F02	1	61	56	**5**
F03	1	60	54	**6**
F04	1	61	52	**8**
F05	1	56	50	**5**
F06	1	56	50	**5**
F07	1	55	50	**5**
F08	1	54	49	4
F09	1	53	49	3
F10	1	52	49	3

X	Indicates noise impact (Substantial Increase)
X	Indicates at least a 5dB benefit

*Values are rounded off and may not reflect typical subtraction results.

TABLE 11: EVALUATED NOISE BARRIER PARAMETERS

Barrier	Insertion Loss (IL)	Height (Range) (ft)	Total Length (ft)	Total Area (ft^2)	Benefitted	Area/ Benefitted	Cost ($48/$ft^2$)
D&F	1-8	13-22	3,220	59,747	16 (71%)	3,734	$2,867,856

Barrier E & G

The land uses in CNE E and G are residential plus one Place of Worship (interior site). If barriers were to be modeled separately for these CNEs, then they would likely overlap into each other's area. Therefore, a set of three overlapping barriers were modeled to analyze mitigation for CNE E and G. The ground-mounted barrier was located near the East-West Freeway mainline with some transitioning to the right-of-way line to maximize its effectiveness. A structure mounted barrier was also analyzed over Harrowgate Road. Tables 12 and 13 show the insertion loss summary and the barrier parameters.

This barrier set has panel heights ranging approximately 10 to 16 feet and a total length of 7,726 feet, resulting in a surface area of approximately 105,006 square feet, based on the vertical profile utilizing TNM, current roadway plans and current cut/fill lines. The barrier would benefit 53 out of 75 impacted sites (71%), plus one non-impacted receptor. This results in a ratio of 1,945 square feet per benefited receptor. This barrier is not considered both feasible and reasonable in accordance with VDOT's State Noise Abatement Policy and is not recommended for construction.

TABLE 12: BARRIER E & G INSERTION LOSS SUMMARY

Impacted Receptor ID Number	Number of Dwelling Units*	Predicted Future Design Build Noise Levels (No Barrier) (dBA)	Predicted Future Design Build Noise Levels (With Barrier) (dBA)	Insertion Loss (IL)** (dBA)
E01	1	66	57	9
E02	1	66	56	10
E03	1	61	55	6
E04	1	60	54	6
E05	1	58	54	5
E06	1	58	53	5
E07	1	58	53	5
E08	1	58	52	6
E09	1	58	52	5
E10	1	54	50	3
E11	1	55	51	4
E12	1	54	50	4
E13	1	54	50	4
E14	1	54	50	4
E15	1	54	51	2
E16	1	56	52	3
E17	1	56	52	3
E18	1	56	53	3
E19	1	55	53	3
E20	1	56	53	3
E21	1	56	53	3
E22	1	57	54	4
E23	1	58	54	5
E24	1	59	54	5
E25	1	59	54	5
E26	1	60	54	6
E27	1	60	53	7
E28	1	61	54	8
E29	1	60	53	7
E30	1	59	52	6
E31	1	57	51	6
E32	1	56	51	5
E33	1	56	51	5
E34	1	56	51	5
E35	1	56	51	5
E36	1	57	51	5
E37	1	57	52	5
E38	1	57	53	4

E39	1	58	54	3
E40	1	66	65	1
E41	1	65	64	1
E42	1	63	62	1
E43	1	65	64	0
E44	1	59	57	1
E45	1	56	53	2
E46	1	55	52	3
E47	1	55	52	3
E48	1	56	52	4
E49	1	55	50	**5**
E50	1	54	50	**5**
E51	1	55	50	**5**
E52	1	56	50	**5**
E53	1	56	51	**5**
E54	1	56	51	**5**
E55	1	57	51	**5**
E56	1	57	52	**5**
E57	1	56	52	4
E58	1	55	52	4
E59	1	54	51	3
E60	1	53	50	3
E61	1	53	51	2
E62	1	54	52	2
E63	1	54	52	2
E64	1	53	51	2
E65	1	54	51	2
E66	1	54	51	3
G05	1	56	55	1
G06	1	54	53	1
G07	1	53	50	2
G08	1	55	52	4
G09	1	51	48	3
G10	1	52	49	3
G11	1	52	49	3
G12	0	37	31	**5**
G13	1	48	45	2
G14	1	52	50	2
G15	1	51	47	3
G16	1	58	52	**5**
G17	1	54	51	3
G18	1	51	47	3

G19	1	54	49	4
G20	1	51	47	3
G21	1	52	47	4
G22	1	56	50	**5**
G23	1	53	48	4
G24	1	60	52	**6**
G25	1	54	50	4
G26	1	55	50	**5**
G27	1	56	50	**5**
G28	1	59	52	**7**
G29	1	60	53	**7**
G30	1	56	50	**5**
G31	1	61	53	**7**
G32	1	56	50	**6**
G33	1	61	52	**8**
G34	1	61	49	**7**
G35	1	56	51	**8**
G36	1	61	49	**7**
G37	1	60	51	**8**
G38	1	56	49	**7**
G39	1	60	50	**8**
G40	1	56	48	**7**
G41	1	55	47	**5**
G42	1	55	48	**5**
G43	1	56	50	**5**

X	Indicates noise impact (Substantial Increase)
X	Indicates noise impact (NAC)
X	Indicates at least a 5dB benefit

*Values are rounded off and may not reflect typical subtraction results.

TABLE 13: EVALUATED NOISE BARRIER PARAMETERS

Barrier	Insertion Loss (IL)	Height (Range) (ft)	Total Length (ft)	Total Area (ft^2)	Benefitted	Area/ Benefitted	Cost ($48/$ft^2$)
E&G	0-10	10-16	7,726	105,006	54 (71%)	1,945	$5,040,298

Barrier J

The land uses in CNE J are residential. The ground-mounted two-barrier set on either side of Happy Hill Road was located near the East-West Freeway mainline with some transitioning to the right-of-way to maximize its effectiveness. Additionally, the very eastern area of CNE G was included because of potential overlapping barriers into each other's CNE areas. Tables 14 and 15 show the insertion loss summary and the barrier parameters.

Barrier J has maximum VDOT panel heights of 30 feet and was not predicted to benefit any receptor. This was due to the highway traffic noise influences from Happy Hill Road/US 1 and with direct access to these sites prohibiting barriers being placed on the driveways. This barrier set is not considered both feasible and reasonable in accordance with VDOT's State Noise Abatement Policy and is not recommended for construction.

TABLE 14: BARRIER A INSERTION LOSS SUMMARY

Receptor ID Number	Number of Dwelling Units	Predicted Future Design Build Noise Levels (No Barrier) (dBA)	Predicted Future Design Build Noise Levels (With Barrier) (dBA)	Insertion Loss (IL)* (dBA)
J01	1	68	65	2
J02	1	66	64	1
J03	1	64	63	0
J04	1	67	66	0
G44	1	64	63	1
G45	1	66	66	0
G46	1	67	66	0
G47	1	64	64	0
X	Indicates noise impact (NAC)			
X	Indicates at least a 5dB benefit			

*Values are rounded off and may not reflect typical subtraction results.

TABLE 15: EVALUATED NOISE BARRIER PARAMETERS

Barrier	Insertion Loss (IL)	Height (Range) (ft)	Total Length (ft)	Total Area (ft^2)	Benefitted	Area/ Benefitted	Cost ($48/$ft^2$)
J	0-2	30	-	-	0 (0%)	-	-

6.5 RAIL NOISE ABATEMENT SUMMARY

Receptors in CNE B, E, G, H, I and K are not likely to be affected by the predicted sound levels as a result of the current conceptual rail alignment since the CNE's are on the other side of the East-West Freeway form the rail line. Therefore, they are not discussed in the generalized rail noise abatement summary below. As mentioned previously in this report, no cut/fill lines, right-of-way requirements or final centerline alignments have been determined at this time for the conceptual rail line.

Overall, the predicted rail sound levels are not expected to increase the total overall sound levels at the noise receptors during the peak highway traffic noise periods with the exception of one site where it increased the sound level by 1 dBA. This is because the predicted highway traffic sound level will be more dominant than the predicted rail sound levels; therefore, the logarithmic addition of the two noise sources produces no (or minimal) sound level increases.

Please note that this also does not mean that the rail noise will not be noticed by the local population, especially if there is a nighttime train pass-by. Nonetheless, for this project analysis, if a receptor site were to be impacted by a rail source, then it has already been predicted to be impacted as a result of the highway noise source.

Barrier A with Rail

Receptor A01 is likely to be acquired if the rail line is constructed since it traverses across the driveway to this residence; and then the cut/fill requirements would also have to be incorporated. If so, then there would be no impacts in CNE A. If not, then the rail noise contribution would be 47 dBA to this site. When added to the 61 dBA highway peak hour sound level, then the total sound level during the peak hour is predicted to be 61 dBA. (Please note that sound levels are added logarithmically.) Additionally, as mentioned above regarding the cut/fill and right-of-way requirements, it is likely that the residence would need to be acquired since it is ~130 feet from the rail centerline.

Barrier C with Rail

The rail line and the receptors in CNE C are on the north side of the East-West Freeway. There is a slight increase in the peak hour sound level for C03, but no additional impacts are predicted. The mitigation analysis for the two predicted highway noise impacts resulted in the barrier not being both feasible and reasonable. If a barrier were placed here for the impacted sites, then it would reduce the rail noise by 5 dBA. However, the highway noise would still be the dominant noise source and, as mentioned, then the mitigation was predicted to not be both feasible and reasonable.

Barrier D&F with Rail

The rail line and the receptors in CNE D&F are on the north side of the East-West Freeway. There are no predicted increases in the peak hour sound level as a result of the rail line. The mitigation analysis for the predicted highway noise impacts in these CNEs resulted in the barrier not being both feasible and reasonable. However, please note that this area is likely to have a design change either for the rail line or the freeway interchange because the preliminary alignments overlap each other in the interchange area.

Barrier J with Rail

Receptor J01 is likely to be acquired if the rail line is constructed since it is within 70 feet of the rail line. There is no change in the predicted peak hour dBA as a result of the rail line for the other receptors in CNE J. The highway noise mitigation analysis for the receptors in CNE J resulted in the minimum reduction not being achieved because of traffic noise from local streets.

7. CONSTRUCTION NOISE CONSIDERATIONS

VDOT is also concerned with noise generated during the construction phase of the proposed project. While the degree of construction noise impact will vary, it is directly related to the types and number of equipment used and the proximity to the noise-sensitive land uses within the project area. Land uses that are sensitive to traffic noise, are also potentially considered to be sensitive to construction noise. Any construction noise impacts that do occur as a result of roadway construction measures are anticipated to be temporary in nature and will cease upon completion of the project construction phase. A method of controlling construction noise is to establish the maximum level of noise that construction operations can generate. In view of this, VDOT has developed and FHWA has approved a specification that establishes construction noise limits. This specification can be found in VDOT's 2007 Road and Bridge Specifications, Section 107.16(b.3), "Noise". The contractor will be required to conform to this specification to reduce the impact of construction noise on the surrounding community.

The specifications have been reproduced below:

- The Contractor's operations shall be performed so that exterior noise levels measured during a noise-sensitive activity shall not exceed 80 decibels. Such noise level measurements shall be taken at a point on the perimeter of the construction limit that is closest to the adjoining property on which a noise-sensitive activity is occurring. A noise sensitive activity is any activity for which lowered noise levels are essential if the activity is to serve its intended purpose and not present an unreasonable public nuisance. Such activities include, but are not limited to, those associated with residences, hospitals, nursing homes, churches, schools, libraries, parks, and recreational areas.
- VDOT may monitor construction-related noise. If construction noise levels exceed 80 decibels during noise sensitive activities, the Contractor shall take corrective action before proceeding with operations. The Contractor shall be responsible for costs associated with the abatement of construction noise and the delay of operations attributable to noncompliance with these requirements.
- VDOT may prohibit or restrict to certain portions of the project any work that produces objectionable noise between 10 PM and 6 AM. If other hours are established by local ordinance, the local ordinance shall govern.
- Equipment shall in no way be altered so as to result in noise levels that are greater than those produced by the original equipment.
- When feasible, the Contractor shall establish haul routes that direct his vehicles away from developed areas and ensure that noise from hauling operations is kept to a minimum.
- These requirements shall not be applicable if the noise produced by sources other than the Contractor's operation at the point of reception is greater than the noise from the Contractor's operation at the same point.

8. PUBLIC INVOLVEMENT PROCESS

8.1 NOISE-COMPATIBLE LAND USE PLANNING

FHWA and VDOT policies require that VDOT provide certain information to local officials within whose jurisdiction the highway project is located to minimize future traffic noise impacts of Type I projects on currently undeveloped lands. (Type I projects involve highway improvements with noise analysis.) This information must include details on noise-compatible land-use planning and noise impact zones for undeveloped lands within the project corridor. The aforementioned details are provided below and the 66 dBA contour line is shown on the graphics in Appendix A, Fig. 2. Additional information about VDOT's noise abatement program has also been included in this section.

Sections 12.1 and 12.2 of VDOT's Highway Traffic Noise Impact Analysis Guidance Manual outline VDOT's approach to communication with local officials and provide information and resources on highway noise and noise-compatible land-use planning. VDOT's intention is to assist local officials in planning undeveloped land adjacent to highways to minimize potential impacts of highway traffic noise.

Entering the Quiet Zone is a brochure that provides general information and examples to elected officials, planners, developers, and the general public about the problem of traffic noise and effective responses to it. There is a link to this brochure provided on FHWA's website. It is located here: http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/land_use/qz00.cfm.

A wide variety of administrative strategies may be used to minimize or eliminate potential highway noise impacts, thereby preventing the need or desire for costly noise abatement structures such as noise barriers in future years. There are five broad categories of such strategies:

- Zoning,
- Other legal restrictions (subdivision control, building codes, health codes),
- Municipal ownership or control of the land,
- Financial incentives for compatible development, and
- Educational and advisory services.

The Audible Landscape: A Manual for Highway and Land Use is a well-written and comprehensive guide addressing these noise-compatible land-use planning strategies, with significant detailed information. There is a link to this document available through the FHWA's Website, at http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/audible_landscape/al00.cfm.

Noise Impact Zones in Undeveloped Land along the Study Corridor

Also required under the revised 2011 FHWA and VDOT noise policies is information on the noise impact zones adjacent to project roadways in undeveloped lands. To determine these zones, noise levels are computed at various distances from the edge of the project roadways in each of the undeveloped areas of the project study area. Then, the distances from the edge of the roadway to the Noise Abatement Criteria sound levels are determined through interpolation. Distances vary in the project corridor due to changes in traffic volumes, or terrain features. Any noise sensitive sites within these zones should be considered

noise impacted if no barrier is present to reduce sound levels. The graphics in ***Figure 2*** show the predicted 66 dB contours for the project.

VDOT's Noise Abatement Program

Information on VDOT's noise abatement program is available on VDOT's Website, at: http://www.virginiadot.org/projects/pr-noise-walls-about.asp. The site provides information on VDOT's noise program and policies, noise walls, and a downloadable noise wall brochure.

8.2 VOTING PROCEDURES

There were no noise barriers determined to be both feasible and reasonable in any CNE. Therefore, this section is not applicable.

9. REFERENCES

Federal Highway Administration. "23 CFR Part 772 - Procedures for Abatement of Highway Traffic Noise and Construction Noise." Federal Register 75.133 (2010): 20. Policy - Final Rule. 25 November 2013. <http://www.gpo.gov/fdsys/pkg/FR-2010-07- 13/pdf/2010-15848.pdf>.

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APPENDICES

APPENDIX A: NOISE STUDY GRAPHICS

Appendix A follows this page.

APPENDIX B: NOISE REPORT GUIDANCE AND ACCOUNTABILITY CHECKLIST AND TNM CERTIFICATION FOR NOISE TECHNICAL MANAGER

Follows Appendix A. The checklist has been included. The TNM certification is on file with VDOT.

APPENDIX C: NOISE MONITORING DATA SHEETS – TNM INPUTS/OUTPUTS

Follows Appendix B. Includes the Calibration Data followed by the Field Measurement Data Sheets. Electronic copies of the TNM Inputs and Outputs will be retained in the technical files.

APPENDIX D: WARRANTED, FEASIBLE, AND REASONABLE WORKSHEETS

Follows Appendix C.

APPENDIX E: LIST OF PREPARERS AND REVIEWERS

Follows Appendix D.

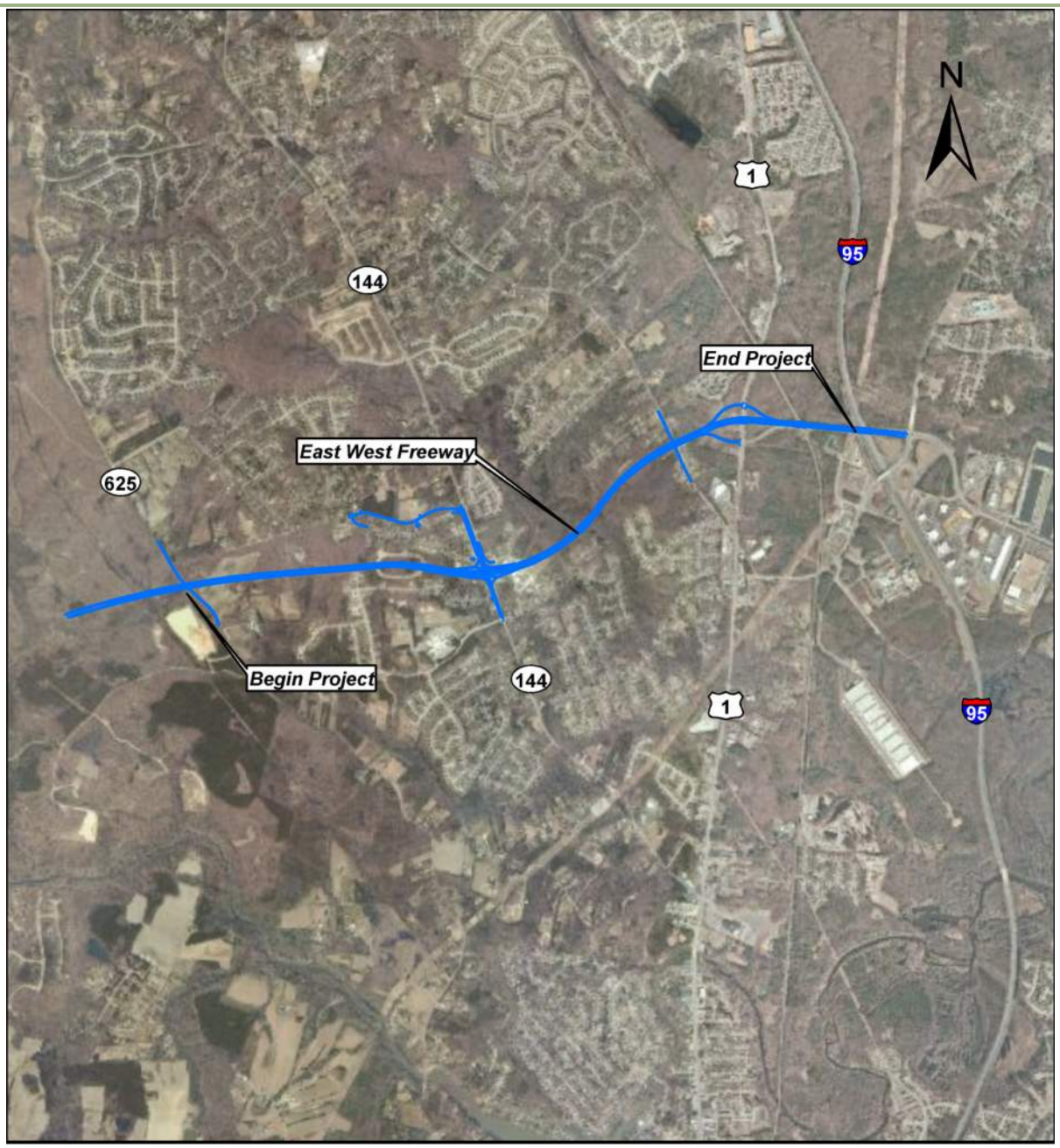
APPENDIX F: TRAFFIC DATA

Follows Appendix E.

APPENDIX G: HB 2577 (AMENDED BY HB 2025)

Follows Appendix F.

APPENDIX A: NOISE STUDY GRAPHICS



Location Map
East - West Freeway
Chesterfield County, Virginia

0 1 Miles

VDOT Virginia Department of Transportation

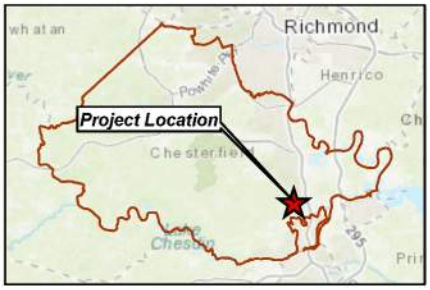
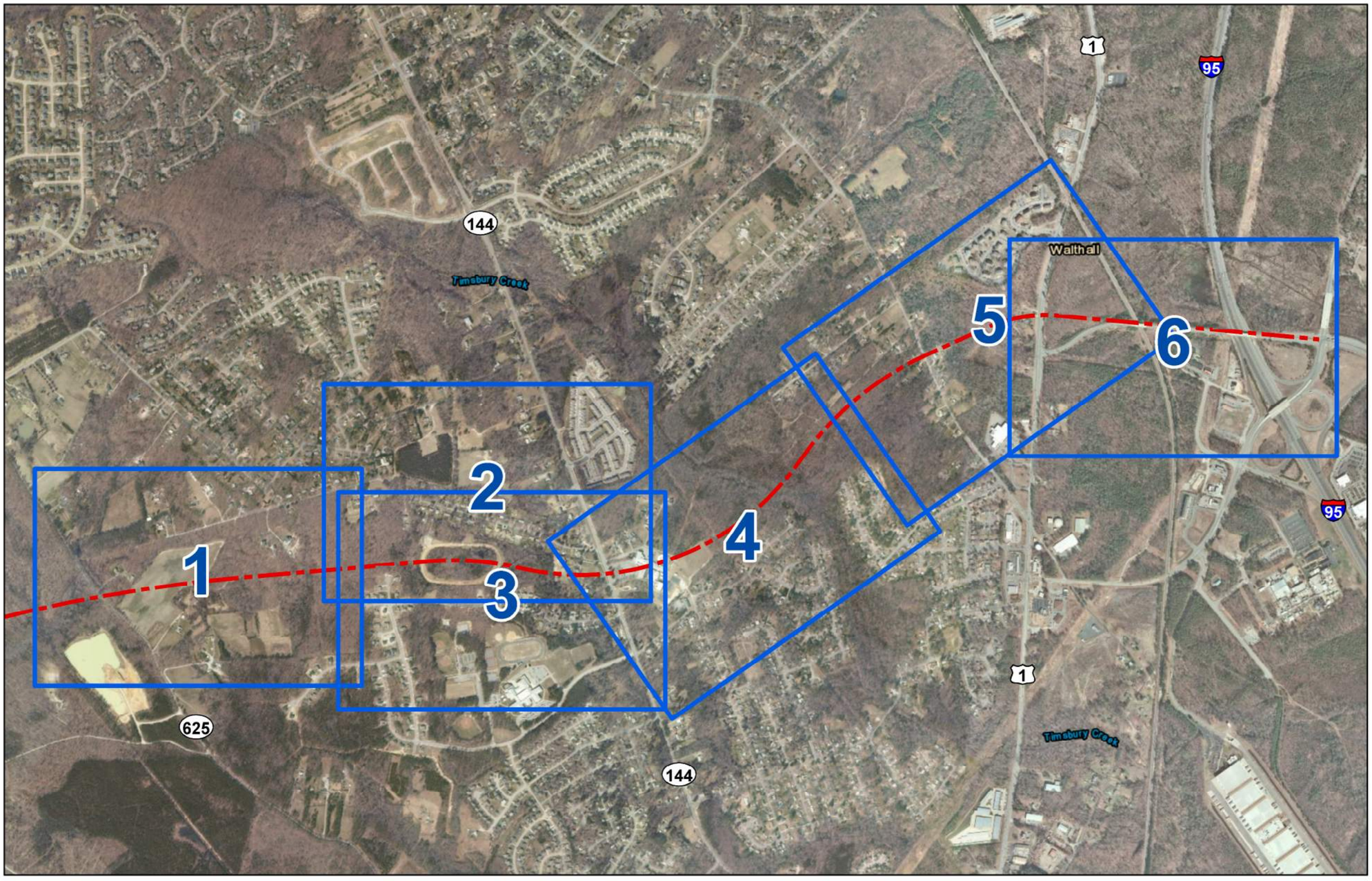


Figure: 1 East-West Freeway Location Map



Legend

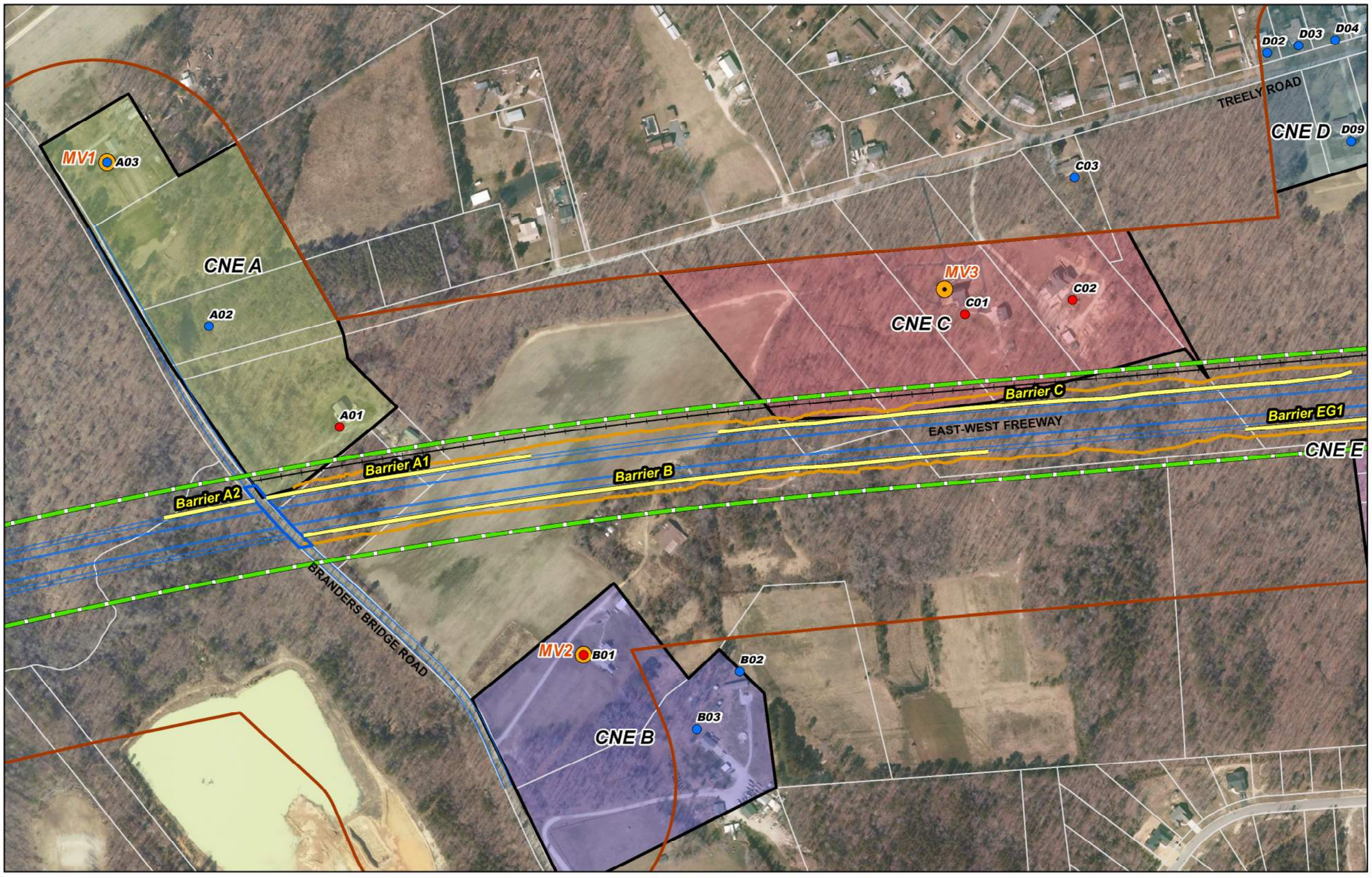
Sheet Index

East - West Freeway Centerline

VDOT Virginia Department of Transportation

Figure: 2
EAST - WEST FREEWAY
SHEET INDEX

Feet
0 1,000 2,000 3,000 4,000



Legend

CNEs

- CNE A
- CNE B
- CNE C
- CNE D
- CNE E
- CNE F
- CNE G
- CNE H
- CNE I
- CNE J
- CNE K

Denotes Not Feasible & Reasonable Barrier

Denotes Proposed Right of Way

Denotes Approximate Location of 66 dBA Sound Contour

Denotes Approximate Location of 500' from EOP

Receptor Site Impacted Not Benefited

Receptor Site Not Impacted or Benefited

Model Validation Site

N

Feet
0 300 600 900 1,200

VDOT Virginia Department of Transportation

Figure: 2
EAST - WEST FREEWAY

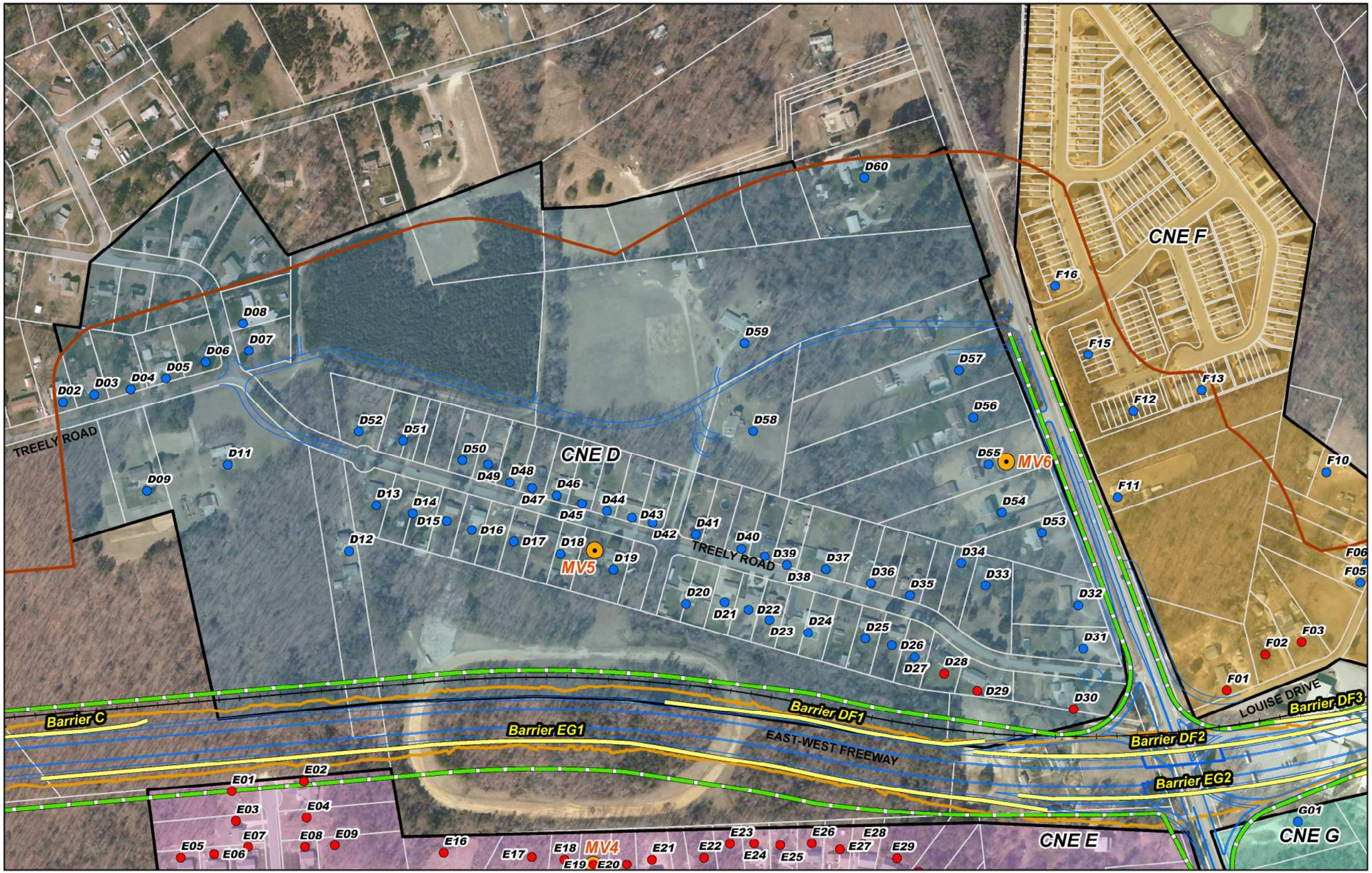
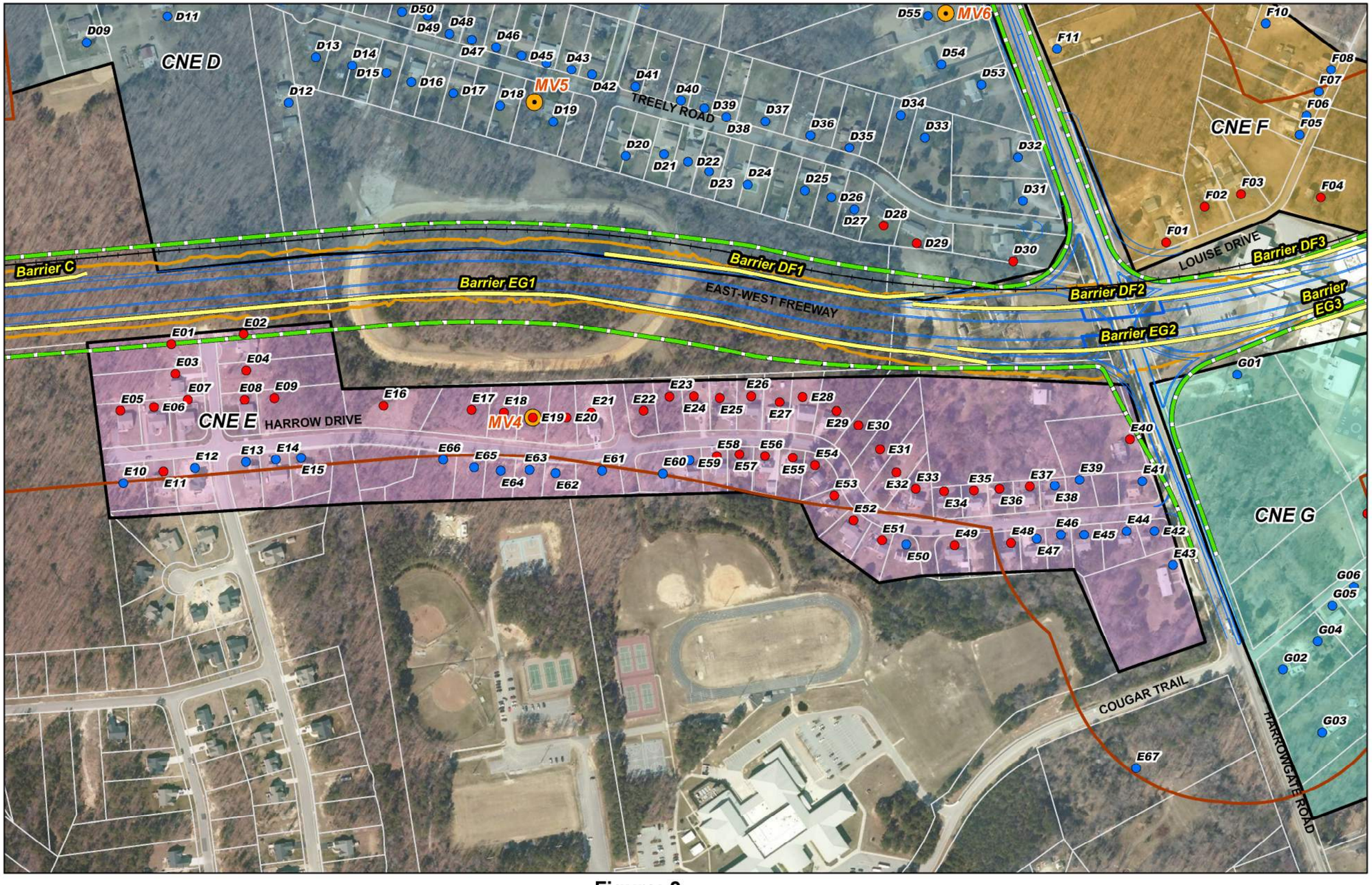


Figure: 2
EAST - WEST FREEWAY



VDOT Virginia Department of Transportation

Figure: 2
EAST - WEST FREEWAY

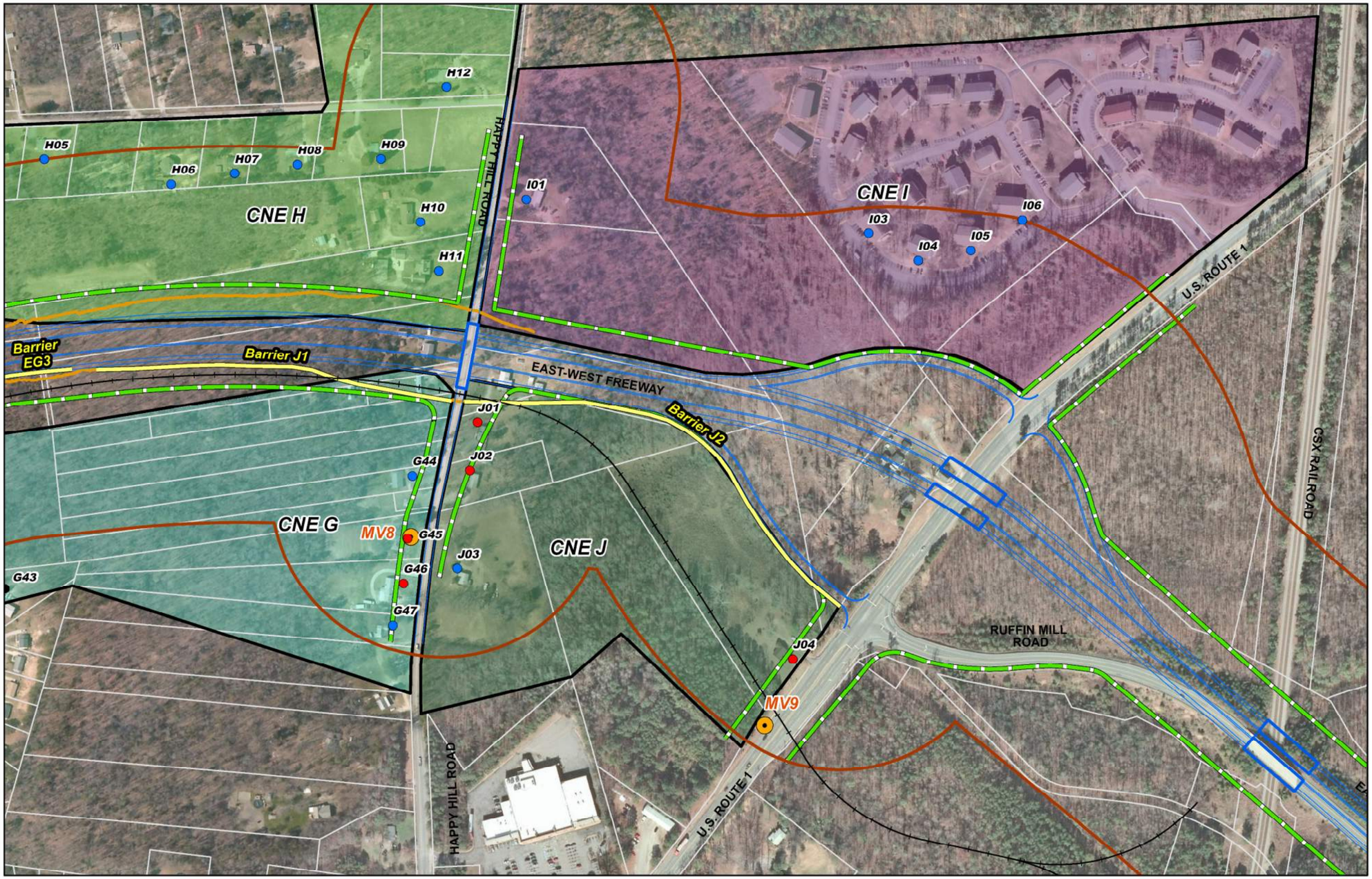


Figure: 2
EAST - WEST FREEWAY

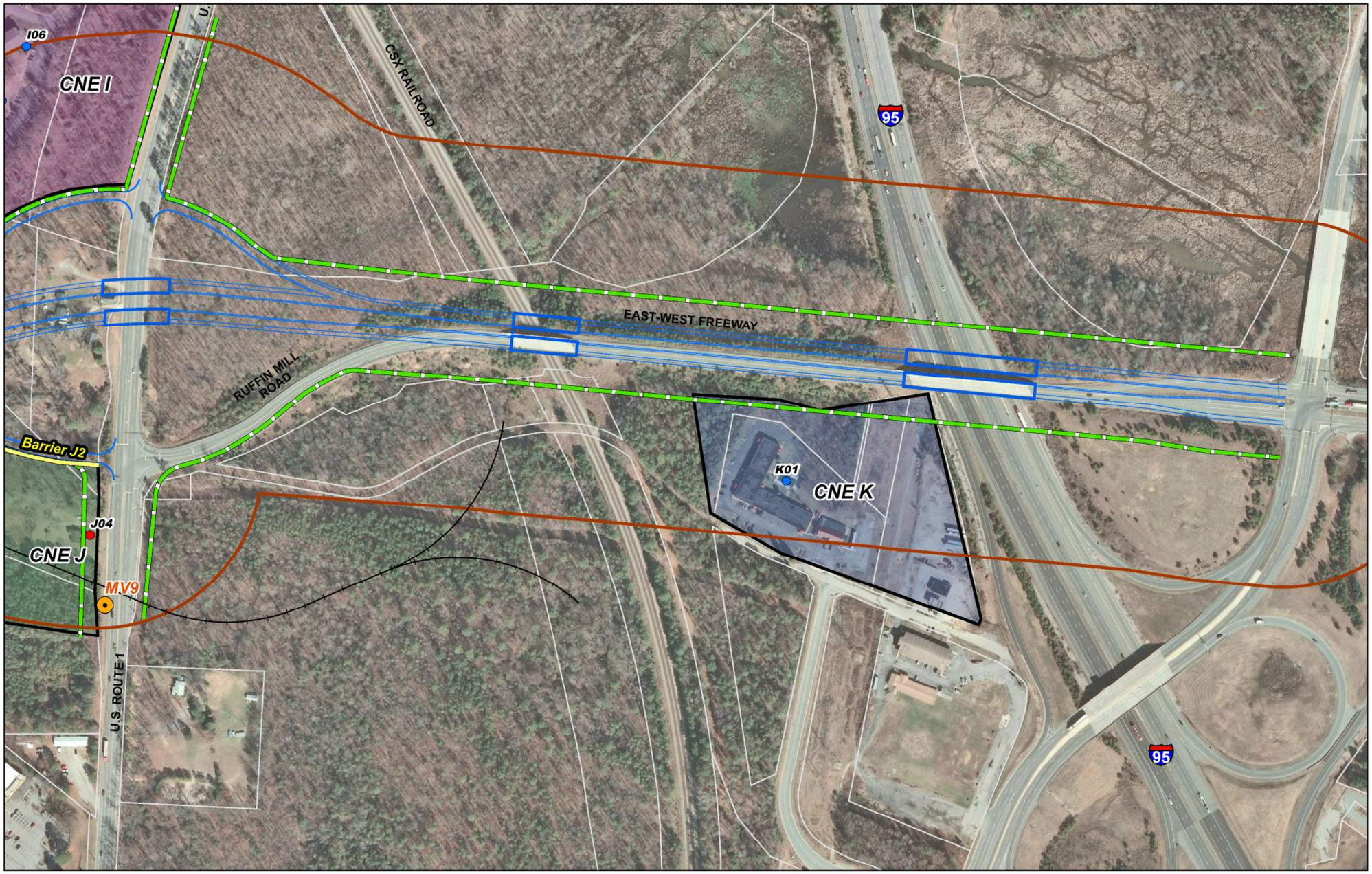


Figure: 2
EAST - WEST FREEWAY

APPENDIX B: GUIDANCE AND ACCOUNTABILITY CHECKLIST

VIRGINIA DEPARTMENT OF TRANSPORTATION
NOISE REPORT GUIDANCE AND ACCOUNTABILITY CHECKLIST

VERSION 3.0

This checklist is not an inclusive document that accounts for all projects. However this guidance checklist outlines the most common items that will be reviewed during VDOT's review process. This checklist follows guidance set forth in VDOT's Highway Traffic Noise Manual.

Checked Items are Required	Preliminary	Final Design		
			UPC:	N/A
			Completed By:	APK @ MBI
			Date:	1/17/18

X	This Item has been verified by the document writer
N/A	This item is "Not/Applicable" to this project
D	This Item is Project Dependent

1.0 TITLE PAGE

1.1	X	✓	✓	- Report is Appropriately Named, with Correct Project Limits, Project Number(s), UPC(s) (Universal Project Code), and Submission Date N/A
1.2	X	✓	✓	- Person Performing the Noise Analysis is Prequalified in the State of Virginia

2.0 TABLE OF CONTENTS (TOC)

2.1	X	✓	✓	- Items listed in TOC are Accurately Numbered, Including the Report Sections, Tables, Figures, Graphics, and Appendices

3.0 EXECUTIVE SUMMARY

3.1	X	✓	✓	- Brief Project Description provided with Project Location Information
3.2	X	✓	✓	- Summary of the Number (and sound level ranges) of Impacts for Existing, No-Build (if applicable), and the Future Design Year
3.3	X	✓	✓	- Noise Abatement Summary and Barrier Analyses Summary - (If Future Design Year Impacts are Predicted)
3.4	X	✓		- "Conversely . . . " Statement Added
3.5	X	✓	✓	- Construction Noise Summary
3.6	X	✓		- Discussion of Futher Noise Abatement Considerations during Final Design - eg. Rail noise, Aviation noise, Reflected Noise from Existing or Proposed Barriers / Retaining Walls, Commitments for further evaluation based on new design information, Alternatives to proposed noise barrier placement. . .

4.0 INTRODUCTION

4.1	X	✓	✓	- Discussion of the Project Description of the Proposed Project. Should include the Project Limits, Number of Proposed Lanes and/or Proposed Modification, Lane Widths etc . . .
4.2	X	✓	✓	- Discussion of the History of the Project, Background, Future Design Year, Specific Pertanent Project Details, Including the Preferred Alternative and other Road Improvements.

Checked Items are Required		Preliminary	Final Design	UPC: N/A Completed By: APK @ MBI Date: 1/17/18	X	This Item has been verified by the document writer
					N/A	This item is "Not/Applicable" to this project
					D	This Item is Project Dependent

4.3	X	✓	✓	- Project Location Figure (See VDOT's Noise Report Development and Guidance Document)
4.4	N/A	D	D	- Acditional NEPA documentation (If Necessary - Documents to support an older ROD or Date of Public Knowledge)

5.0 METHODOLOGY

5.1	X	✓	✓	- FHWA and State Policy Discussion and Compliance Regulations
5.2	X	✓	✓	- Sound Level Metrics Defined
5.3	X	✓	✓	- NAC Defined
5.4	X	✓	✓	- Definiton of Noise Impact
5.5	X	✓	✓	- Analysis Proceedure Defined
5.6	X	✓	✓	- TNM Model Version Defined and Program Overview Description given

Source of Model Inputs Documented

5.7	X	✓	✓	- Discussion of the Source of Design Files / Typical Sections/ Profiles / Cross Sections, or Study Corridor Limits if Engineering is not Available
5.8	X	✓	✓	- Discussion of Traffic Volumes / Speeds / Truck %'s
5.9	X	✓	✓	- Document the Source of Survey Information
5.10	N/A	D	D	- Additional Data (Existng or Proposed Retaining Walls, Existing Noise Barriers or Berms, GIS Layers and/or Supplemental Elevation Data)

6.0 EXISTING NOISE ENVIRONMENT

6.1 NOISE MONITORING

6.1.1	X	✓	✓	- Noise Monitoring Methodology is Clearly Defined
6.1.2	X	✓	✓	- The Date(s) of Monitoring are Documented
6.1.3	X	✓	✓	- Type of Meter is Noted and Pertainent Calibration Information is Included
6.1.4	X	✓	✓	- Number of Sites (Short-term or Long-term) are Identified and Located on Figure

Checked Items are Required		Preliminary	Final Design	UPC: N/A Completed By: APK & MBI Date: 1/17/18	X	This Item has been verified by the document writer
					N/A	This item is "Not/Applicable" to this project
					D	This Item is Project Dependent

6.1.5	X	✓	✓	- Documentation of Noise Monitoring Data Sheets and other monitoring factors such sampling interval, weather . . .
6.1.6	X	✓	✓	- Table and Discussion of Ambient Noise Monitoring Results and Required Sample Text Regarding Monitoring
6.1.7	X	✓	✓	- Table and Discussion of Noise Validation Results
6.2	**UNDEVELOPED LANDS AND PERMITTED DEVELOPMENTS**			
6.2.1	X	✓	✓	- "Undeveloped Lands and Permitted Developments" Sample Text Added
6.2.2	X	✓	✓	- Documentation of the Coordination Dates and Contact Information for the Undeveloped Lands and Permitted Developments Search
6.3	**COMMON NOISE ENVIRONMENT (CNE) DETERMINATION**			
6.3.1	X	✓	✓	- Are all Noise Sensitive Receptors within at least 500 feet of the Proposed Edge of Pavement Considered for Evaluation?
6.3.2	X	✓	✓	- Discussion of Existing Land Uses for each CNE
6.3.3	X	✓	✓	- Are all non noise sensitive land uses addressed in the report (reasons why they are not noise sensitive)?
6.3.4	X	✓	✓	- CNE's Boundaries Located on Figure
6.4	**WORST NOISE HOUR**			
6.4.1	X	✓	✓	- The Worst Noise Hour selected needs to be the same for ALL roadways. Review to ensure this is accurate.
6.4.2	X	✓	✓	- Discussion of the Selection of the Worst Noise Hour
6.4.3	N/A	✓	✓	- Was 24-Hour (Long Term Monitoring) Utilized to Determine the Worst Noise Hour
6.4.4	N/A	D	D	- State if Multiple Sets of TNM runs were Created / Modeled to Determine the Worst Noise Hour (or were there dual worst noise hours)
6.4.5	N/A	D	D	- Were other Factors Considered for the Selection of the Worst Noise Hour
6.5	**RECEPTOR IDENTIFICATION AND NAC CATEGORIZATION**			
	If NAC A's are present, is the Criteria met and the Items Listed Below are Discussed:			
6.5.1	N/A	D	D	- Serenity and Quiet - The site under consideration meets the serenity and quiet criterion if the current Leq noise level does not approach or exceed the Activity Category A Noise Abatement Criterion (NAC) during any period when serving its intended purpose.

Checked Items are Required		Preliminary	Final Design	UPC: N/A Completed By: APK @ MBI Date: 1/17/18	X	This Item has been verified by the document writer
					N/A	This item is "Not/Applicable" to this project
					D	This Item is Project Dependent

6.5.2	N/A	D	D	- Public Need - The site under consideration provides an important benefit of the public visiting or using the site due to its historical, religious, cultural, or natural significance
6.5.3	N/A	D	D	- Intended Purpose - Is the Preservation of Serenity and Quiet Essential to Continue to Serve its Intended Purpose
6.5.4	N/A	D	D	- Frequent Human Use - Can the public can access the site during all times when it is available and able to serve its intended purpose?
6.5.5	N/A	D	D	- Is the FHWA Supporting Documentation Included

If NAC B's are present, is the Criteria met and the Items Listed Below are Discussed:

6.5.5	X	D	D	- Are the Number of Receptors Equal to or Representative to a Number of Dwelling Units
6.5.6	X	D	D	- Are there Multi-floor Residential Units and do they have Outdoor Use Areas
6.5.7	N/A	D	D	- Are Outdoor Use Areas (Balconies) Identified and Discussed

If NAC C's are present, is the Criteria met and the Items Listed Below are Discussed:

6.5.8	N/A	D	D	- Are the Outdoor Use Areas Documented for Each of the Identified Receptors
6.5.9	N/A	D	D	- Was the "Grid system" Used and Shown on Figures for Recreational Areas, Trails, Campgrounds, Cemeteries, etc. . .

If NAC D's are present, is the Criteria met and the Item Listed Below is Discussed:

6.5.10	X	D	D	- Discuss the Building Materials and Interior Reduction Factor for each Identified Receptor

If NAC E's are present, is the Criteria met and the Item Listed Below is Discussed:

6.5.11	N/A	D	D	- Are Outdoor Use Areas Identified and Discussed
6.5.12	N/A	D	D	- If "No", Text Should be Provided that the Land Use was Identified but not Evaluated due to the Lack of Outdoor Use

Historic Properties

6.5.13	N/A	D	D	- Discuss if any Section 106 (Historic) Properties were Identified
6.5.14	N/A	D	D	- Discuss if any Section 4(f) Properties were Identified

Checked Items are Required		Preliminary	Final Design	UPC: N/A Completed By: APK @ MBI Date: 1/12/18	X	This Item has been verified by the document writer
					N/A	This item is "Not/Applicable" to this project
					D	This Item is Project Dependent

6.5.15	N/A	D	D	- If Section 4(f) Properties are Identified, Does it Constitute a "Constructive Use" Determination

6.6 MODELED EXISTING ENVIRONMENT

6.6.1	X	✓	D	- Are Existing and Future Design Years Stated
6.6.2	N/A	D	D	- Are Existing Noise Barriers Present within the Proposed Project Area
6.6.3	N/A	D	D	- If Existing Noise Barriers are Present, Does the Project Involve In-Kind Barrier Replacement
6.6.4	X	✓	✓	- Discussion of the Overall Numbers of Existing Condition Impacts and Sound Level Ranges (all CNEs)
6.6.5	X	✓	✓	- Discussion of the Determination and Identification of Noise Impacts (by CNE under Existing Condition)
6.6.6	X	✓	D	- Existing Noise Environment discussion

7.0 FUTURE NOISE ENVIRONMENT

7.1 MODELED FUTURE ENVIRONMENT

7.1.1	X	✓	✓	- Is there Documentation why a No-Build Condition evaluation was/wasn't warranted?
7.1.2	N/A	D	D	- Discussion of the Overall Numbers of No-Build Condition Impacts and Sound Level Ranges (all CNEs)
7.1.3	N/A	D	D	- Discussion of the Determination and Identification of Noise Impacts (by CNE under No-Build Condition)
7.1.4	X	✓	✓	- Discussion of the Overall Numbers of Build Condition Impacts and Sound Level Ranges (all CNEs)
7.1.5	X	✓	✓	- Discussion of the Determination and Identification of Noise Impacts (by CNE under Build Condition)
7.1.6	X	✓	D	- Comparison of existing and future total noise levels for all identified receptors
7.1.7	X	✓	✓	- Future Noise Environment Discussion
7.1.8	X	✓	✓	- Table of Predicted Noise Levels (By CNE)

7.2 NOISE ABATEMENT DETERMINATION

7.2.1	X	✓	✓	- Alternative Abatement Measures Discussion

Checked Items are Required		Preliminary	Final Design	UPC:	N/A	X	This Item has been verified by the document writer
				Completed By:	APK @ MBI	N/A	This item is "Not/Applicable" to this project
				Date:	1/17/18	D	This Item is Project Dependent

7.2.2	X	✓	✓	- Was VDOT's Single Receptor Methodology Utilized?

WARRANTED CRITERIA

7.2.3	X	✓	✓	- Is Warranted Criteria Defined?
7.2.3.1	X	✓	✓	- NAC Impact Definition ("Approach or Exceed") Provided
7.2.3.2	X	✓	✓	- Substantial Increase Impact Definiton Provided
7.2.3.3	X	✓	✓	- Has the NAC for Each Evaluated Land Use Category been Defined

FEASIBILITY CRITERIA

7.2.4	X	✓	✓	- Is Feasibility Defined?
7.2.4.1	X	✓	✓	- Included definition regarding "Are at least 50% of the impacted receptors predicted to experience at least a 5dB(A) benefit?"
7.2.4.2	X	✓	✓	- Included definition regarding "Is the barrier able to be constructed?"

REASONABLENESS CRITERIA

7.2.5	X	✓	✓	- Is Reasonableness Defined?
7.2.5.1	X	✓	✓	- Included definition regarding "Noise Reduction Design Goals"
7.2.5.2	X	✓	✓	- Included definition regarding "Cost-effectiveness"
7.2.5.3	X	✓	✓	- Included definition regarding "The Viewpoints of the Benefited Receptors"

NOISE BARRIER EVALUATION

7.2.6	X	✓	✓	- Barrier Documentation should Include: Discussion of Total Number of Impacts, Benefitted Impacts, Additional Benefits, Total Benefits, Feasibility, Reasonablity, Barrier Length, Range of Panel Heights, Barrier Location, Ground or Structure Mounted, Barrier Systems, etc. . .
7.2.7	X	✓	✓	- Reason for Barrier Placement, Barrier Termini, Barrier Location etc. . .
7.2.8	X	✓	✓	- All Evaluated Barrriers shown on Figures
7.2.9	X		✓	- Barriers were Optimized to Maximize Benefits while Minimizing Cost (Diminishing Returns)

Checked Items are Required		Preliminary	Final Design	UPC: N/A Completed By: APK @ MBI Date: 1/17/18	✖ This Item has been verified by the document writer N/A This item is "Not/Applicable" to this project D This Item is Project Dependent

7.2.10	X	✓	✓	- Table was included that shows the Barrier name, Insertion Loss, Panel Height Range, Total Length, Total Surface Area, Total Benefits, Total sq.ft. / no. of benefits, Cost (for Planning Purposes Only)
7.2.11	X	✓	✓	- Table that shows the Sound Levels, Barrier Insertion Loss for each Receptor included in the Barrier Analysis
7.2.12	N/A	D	✓	- Table that shows the Approximate Stationing, Northing, Easting, Bottom and Top of barrier, Panel Heights by Segment
7.2.13	X	D	D	- Does the Barrier (System) Work Independently or is it Dependent on Another Barrier (Existing or Proposed)
8.0	**CONSTRUCTION NOISE**			
8.1	X	✓	✓	- Construction Noise Discussion
9.0	**PUBLIC INVOLVEMENT PROCESS**			
9.1	**NOISE COMPATIBLE CONTOURS**			
9.1.1	X	✓	✓	- 66 dBA Contour Discussion and Shown on Figure(s)
9.1.2	X	D	D	- Discussion of Public Involvement Efforts (including Community Information Meetings, Individual Meetings, and Special Coordination)
9.2	**VOTING PROCEEDURES**			
9.2.1	X	✓	✓	- Voting Process Defined?
9.2.2	N/A		✓	- How many / when were Certified Letters Sent?
9.2.3	N/A		✓	- What were the Voting Results Related to Desire for a Barrier?
9.2.4	N/A		✓	- Summary of Barrier Survey Results and Comments?
9.2.5	N/A		✓	- How many Surveys were Unresponsive or Undeliverable?
9.2.6	N/A		✓	- Voting Graphic showing the Results of the Barrier Survey?
9.2.7	N/A		✓	- Were there any Special Abatement Commitments / Acoustic Profiles/ Aesthetics Considerations
9.2.8	N/A		✓	- Is this an Addendum Report with Revised Impact / Barrier Results

Checked Items are Required		Preliminary	Final Design	UPC:	N/A
				Completed By:	APK @ MBI
				Date:	1/17/18

X	This Item has been verified by the document writer
N/A	This item is "Not/Applicable" to this project
D	This Item is Project Dependent

10.0 OTHER CONSIDERATIONS

10.1	N/A	D	D	- Absorptive or Reflective Noise Barriers Proposed?
10.2	N/A	D	D	- Was Reflection Noise Considered?
10.3	N/A	D	D	- Was Structure Noise Considered?
10.4	X	D	D	- Was Rail or Aviation Noise Considered?

11.0 APPENDICES

11.1	X	✓	✓	- List of References
11.2	X	✓	✓	- List of Preparers / Reviewers
11.3	X	✓	✓	- Traffic Data
11.4	X	✓	✓	- Noise Monitoring Field Logs
11.5	X	✓	✓	- Warranted, Feasible, Reasonable, Worksheets
11.6	X	✓	✓	- Alternative Mitigation Measures Response Form from Project Manager
11.7	X	✓	✓	- Other Site Sketches of Monitored Locations, Noise Meter Printouts, Noise Meter Calibration Reports, Pertinent Correspondance
11.8	X	✓	✓	- TNM Certification Certificates
11.9	X	✓	✓	- Noise Report Guidance and Accountability Form

12.0 TNM RUNS

12.1	X	✓	✓	- Actual TNM Runs (Electronic Files) must be Submitted for Review with Report, TNM Output Tables are Not Required for Inclusion into the Report, However a Copy of the Printed Modeling Information shall be Supplied Upon Request

13.0 GENERAL

13.1	X	✓	✓	- Figures were Developed in Accordance with VDOT's Noise Report Development and Guidance Document

APPENDIX C: NOISE MONITORING DATA SHEETS-TNM INPUTS/OUTPUTS

The Noise Meter/Microphone calibration certificates are shown, followed by the Noise Monitoring Data Sheets.

The electronic TNM input/output files have been submitted separately to VDOT.

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.35911

Instrument: **Microphone**
Model: **1229**
Manufacturer: **Norsonic**
Serial number: **00529**
Composed of:

Date Calibrated: **3/24/2016** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No

Customer: **Michael Baker Jr., Inc.**
Tel/Fax: **412-269-4644/**
Address: **100 Airside Drive, Moon Township, PA 15108**

Tested in accordance with the following procedures and standards:
Calibration of Measurement Microphones, Scantek, Inc., Rev. 2/25/2015

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 20, 2015	Scantek, Inc./ NVLAP	Jul 20, 2016
DS-360-SRS	Function Generator	88077	Sep 9, 2014	ACR Env./ A2LA	Sep 9, 2016
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 24, 2015	ACR Env./ A2LA	Sep 24, 2016
HM30-Thommen	Meteo Station	1040170/39633	Oct 23, 2015	ACR Env./ A2LA	Oct 23, 2016
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	28326	Nov 10, 2015	Scantek, Inc./ NVLAP	Nov 10, 2016
1203-Norsonic	Preamplifier	92268	Oct 14, 2015	Scantek, Inc./ NVLAP	Oct 14, 2016
4180-Brüel&Kjær	Microphone	2246115	Oct 26, 2015	NPL-UK / UKAS	Oct 26, 2017

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Valentin Bazdaga
Signature		Signature	
Date	3/24/16	Date	3/27/2016

Document stored as: Z:\Calibration Lab\Mic 2016\NOR1229_00529_M1.doc

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.35910

Instrument: **Acoustical Calibrator**
Model: **407744**
Manufacturer: **Extech**
Serial number: **Z206457**
Class (IEC 60942): **2**
Barometer type:
Barometer s/n:

Date Calibrated: **3/24/2016** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: **__Yes _X_ No**

Customer: **Michael Baker Jr., Inc.**
Tel/Fax: **412-269-4644 /**
Address: **100 Airside Drive, Moon Township, PA 15108**

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 1/16/2015

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31061	Jul 20, 2015	Scantek, Inc./ NVLAP	Jul 20, 2016
DS-360-SRS	Function Generator	88077	Sep 9, 2014	ACR Env./ A2LA	Sep 9, 2016
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Sep 24, 2015	ACR Env./ A2LA	Sep 24, 2016
HM30-Thommen	Meteo Station	1040170/39633	Oct 23, 2015	ACR Env./ A2LA	Oct 23, 2016
140-Norsonic	Real Time Analyzer	1403978	Mar 17, 2016	Scantek, Inc. / NVLAP	Mar 17, 2017
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4192-Brüel&Kjær	Microphone	2854675	Nov 11, 2015	Scantek, Inc. / NVLAP	Nov 11, 2016
1203-Norsonic	Preamplifier	92268	Oct 14, 2015	Scantek, Inc./ NVLAP	Oct 14, 2016

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Valentin Buzduga
Signature		Signature	
Date	3/24/16	Date	3/27/2016

Document stored as: Z:\Calibration Lab\Cal 2016\Ex407744_Z206457_M1.doc

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.35912

Instrument: **Sound Level Meter**
Model: **132**
Manufacturer: **Norsonic**
Serial number: **1322870**
Tested with: **Microphone 1229 s/n 00529**
Preamplifier na s/n -
Type (class): **2**
Customer: **Michael Baker International, Inc.**
Tel/Fax: **412-269-4644 /**

Date Calibrated: **3/25/2016** *Cal Due:*

Status:	**Received**	**Sent**
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: __Yes _X_ No
Calibration service: __ Basic _X_ Standard
Address: **100 Airside Drive, Moon Township, PA 15108**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/26/2015
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 23, 2015	Scantek, Inc./ NVLAP	Oct 23, 2016
DS-360-SRS	Function Generator	33584	Oct 20, 2015	ACR Env./ A2LA	Oct 20, 2017
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Oct 6, 2015	ACR Env. / A2LA	Oct 6, 2016
HM30-Thommen	Meteo Station	1040170/39633	Oct 23, 2015	ACR Env./ A2LA	Oct 23, 2016
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 10, 2015	Scantek, Inc./ NVLAP	Nov 10, 2016

Jul 24, 2016

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
22.9	99.20	46.4

Calibrated by:	Jeremy Gotwalt	**Authorized signatory:**	Valentin Bozduga
Signature		Signature	
Date	3/25/16	Date	3/27/2016

Document stored Z:\Calibration Lab\SLM 2016\NOR132_1322870_M2.doc

MEASUREMENT SITE 1

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744

CALIBRATION: START _____ dB END _____ dB

RESPONSE: FAST _____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 71° Partly cloudy

49.8 dB(a)

TRAFFIC DATA		
ROAD		
AUTOS	~~HT HT~~ || 12	
MED TRKS		
HVY TRKS	1 1	
DURATION		

DATE: _____

SITE #: M1 - 15401 Branders Bridge

START: 11:15

END: 11:35

LEQ: 49.8

SPEED: _____

SITE SKETCH

BrandersBridge

	Near (NB)	Far (SB)
Cars	12	20
MT	-	-
HT	2	3

15401 BRANDERS BRIDGE

BACKGROUND NOISE _____

MAJOR SOURCES _____

UNUSUAL EVENTS _____

OTHER NOTES _____

MEASUREMENT SITE 2

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744

CALIBRATION: START _____ dB END _____ dB

RESPONSE: FAST _____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 57° SUNNY 44.4 dB(a)

TRAFFIC DATA		
ROAD		
AUTOS	//// //// //// ///	19
MED TRKS	1	1
HVY TRKS	///	5
DURATION		

near side

DATE: _____

SITE #: M2 — 1580 Branders Bridge

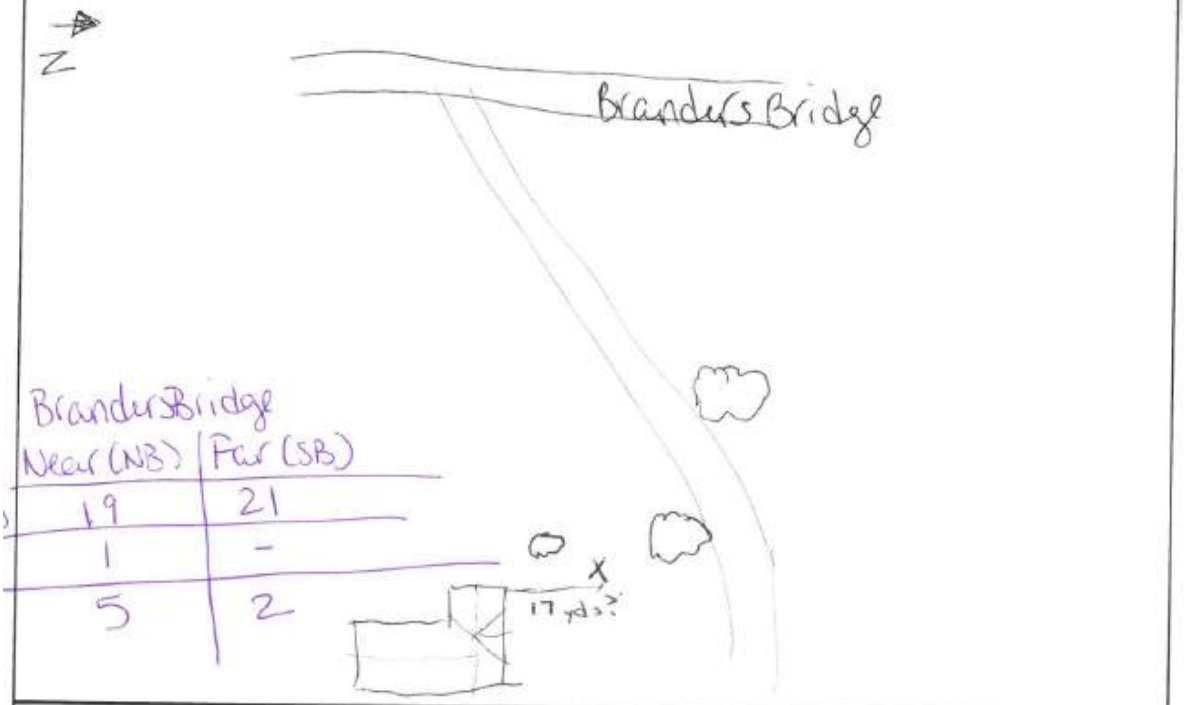
START: _____

END: _____

LEQ: 44.4

SPEED: _____

SITE SKETCH



BACKGROUND NOISE industrial across street, chainsaw, distant train

MAJOR SOURCES _____

UNUSUAL EVENTS _____

OTHER NOTES _____

Michael Baker Jr., Inc. 2005

MEASUREMENT SITE 3

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744

CALIBRATION: START _____ dB END _____ dB

RESPONSE: FAST _____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 72° CLEAR

TRAFFIC DATA		
ROAD		
AUTOS		
MED TRKS		
HVY TRKS		
DURATION		

DATE: _____

SITE #: M3 - 4511 EvesLane

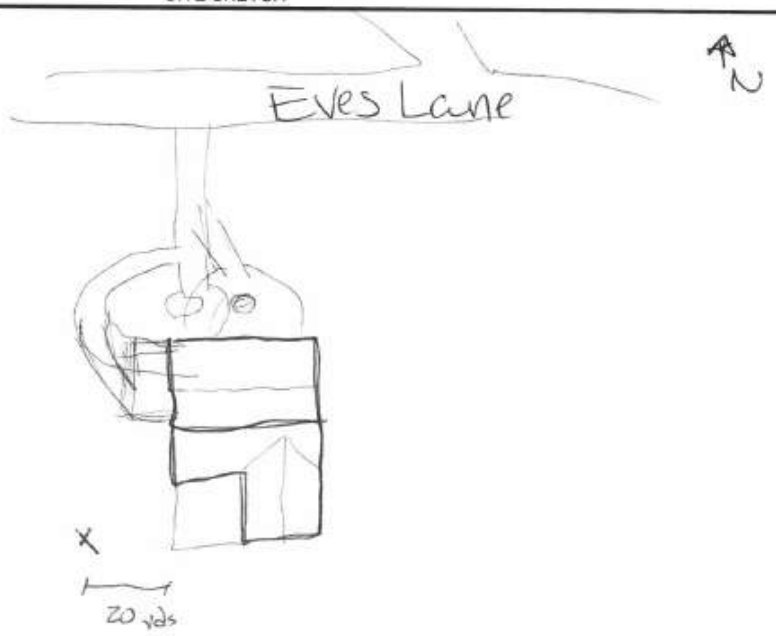
START: _____

END: _____

LEQ: 37.0 dB(a)

SPEED: _____

SITE SKETCH



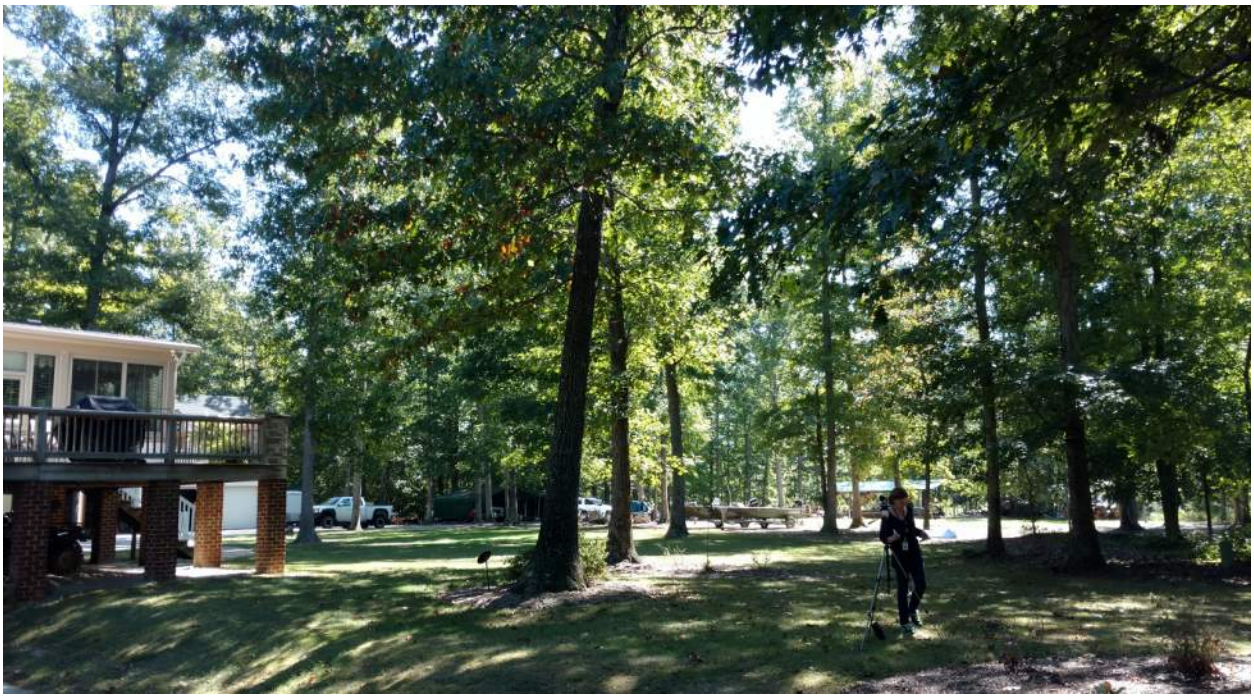
BACKGROUND NOISE _____

MAJOR SOURCES _____

UNUSUAL EVENTS _____

OTHER NOTES _____

Michael Baker Jr., Inc. 2005



MEASUREMENT SITE 4

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744

CALIBRATION: START _____ dB END _____ dB

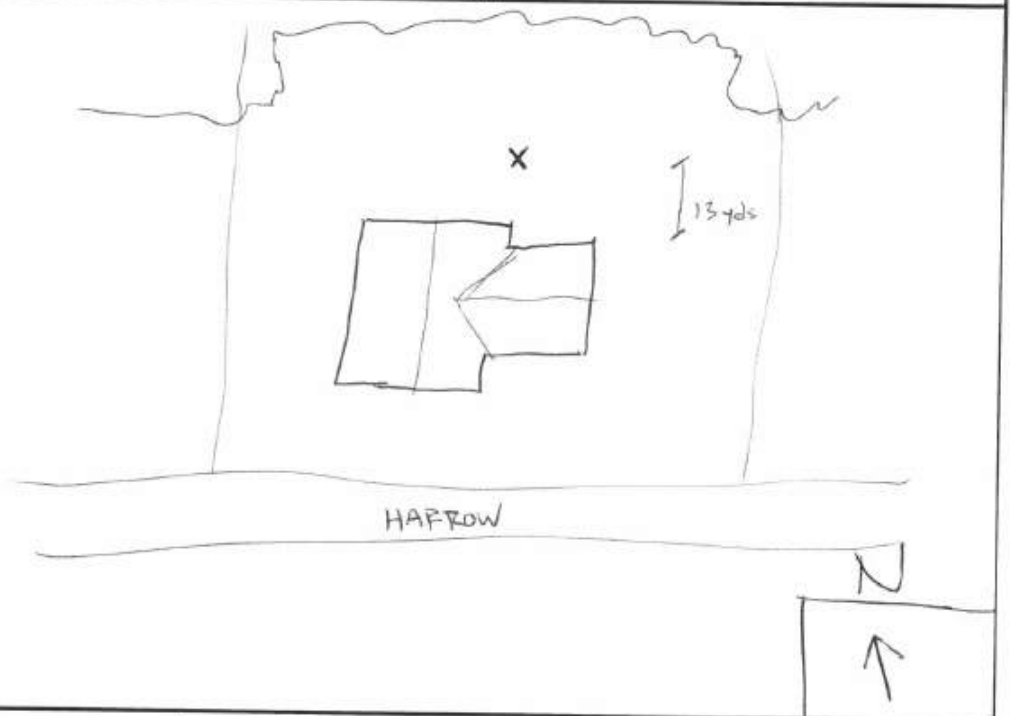
RESPONSE: FAST _____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 56° CLEAR, CALM

TRAFFIC DATA		
ROAD		
AUTOS	1	
MED TRKS		
HVY TRKS		
DURATION		

DATE: 10/4
SITE #: M4 3912 HARROW
START: 9:50
END: 10:10
LEQ: 45.0
SPEED: _____

SITE SKETCH



BACKGROUND NOISE dryer vent, distant siren, prop plane at 5:20 & 7:30
MAJOR SOURCES Robyn drops everything at 7:00
UNUSUAL EVENTS dogs next door
OTHER NOTES _____

Michael Baker Jr., Inc. 2005

MEASUREMENT SITE 5

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744

CALIBRATION: START _____ dB END _____ dB

RESPONSE: FAST ____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 74°, clear

TRAFFIC DATA		
ROAD		
AUTOS	~~IIII IIII~~	10
MED TRKS		
HVY TRKS		
DURATION		

near

DATE: _____

SITE #: MS - 400 Treely Rd.

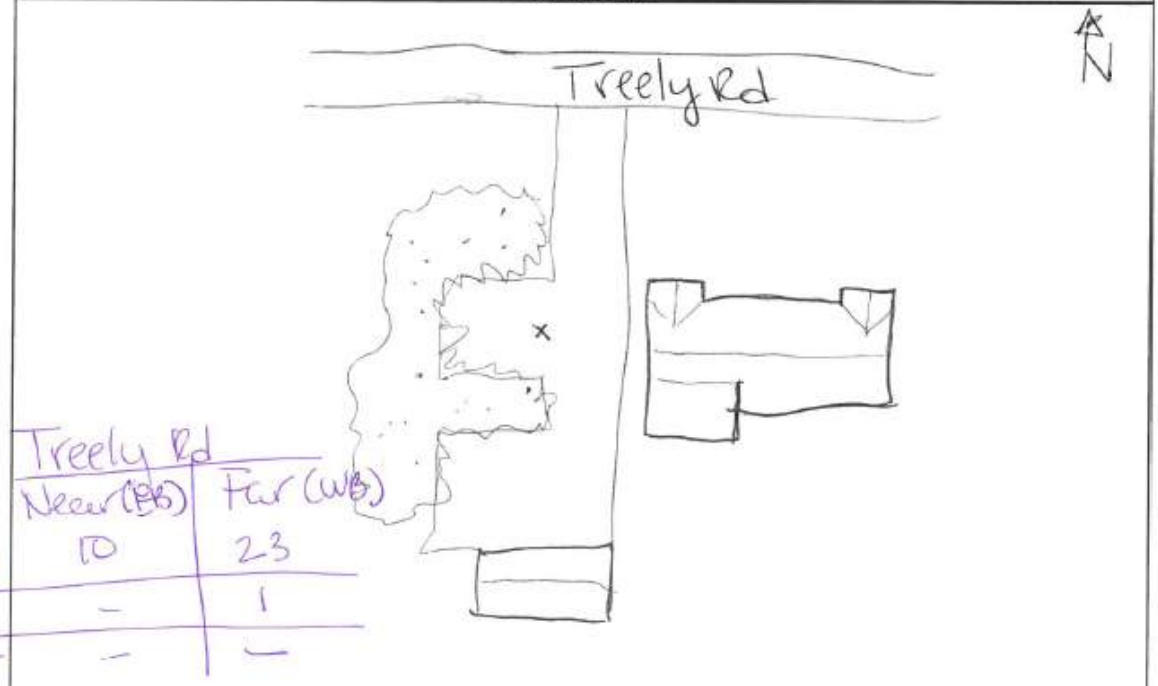
START: _____

END: _____

LEQ: 49.7

SPEED: _____

SITE SKETCH



Treely Rd

Near (EB)	Far (WB)
10	23
–	1
–	–

BACKGROUND NOISE lawnmower

MAJOR SOURCES _____

UNUSUAL EVENTS _____

OTHER NOTES _____

MEASUREMENT SITE 6

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744

CALIBRATION: START _____ dB END _____ dB

RESPONSE: FAST _____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 76° clear

TRAFFIC DATA		
ROAD		
AUTOS	~~HHH HHH HHH HHH HHH~~ 77	
MED TRKS	1	
HVY TRKS		
DURATION		

SEMI BWS ~~HHH~~ II 7

DATE: 30ct17

SITE #: M6 - 5230 Harrowgate Rd

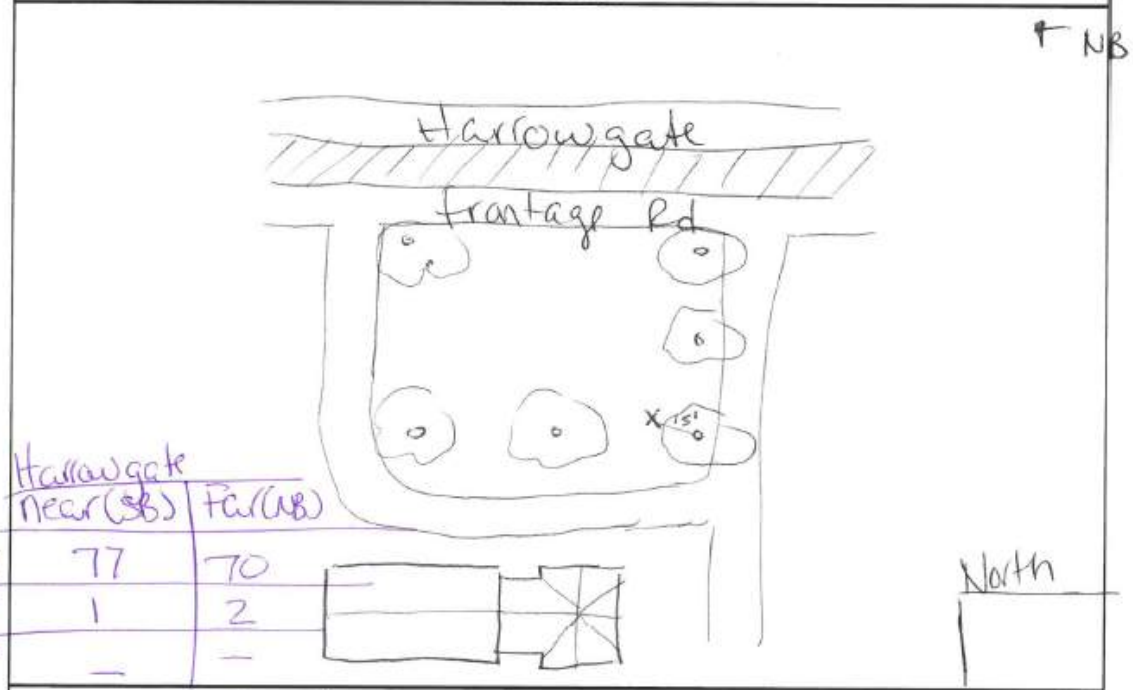
START: _____

END: _____

LEQ: 54.9

SPEED: _____

SITE SKETCH



Harrowgate	
Near (SB)	Far (NB)
77	70
1	2
—	—

BACKGROUND NOISE planes, several

MAJOR SOURCES _____

UNUSUAL EVENTS _____

OTHER NOTES _____

MEASUREMENT SITE 7

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744

CALIBRATION: START _____ dB END _____ dB

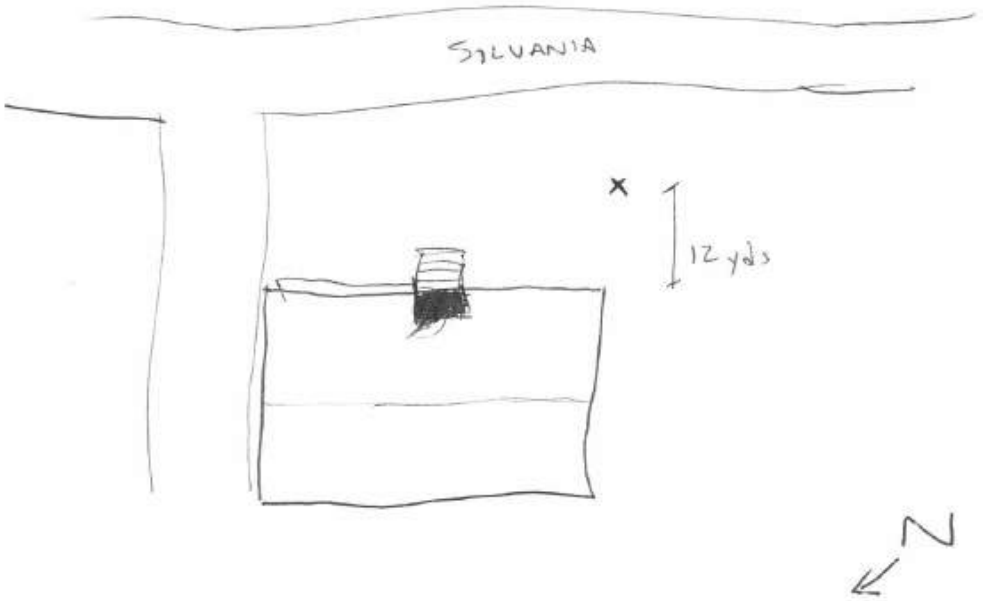
RESPONSE: FAST _____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 70° CLEAR & CALM

TRAFFIC DATA		
ROAD		
AUTOS		
MED TRKS		
HVY TRKS		
DURATION		

DATE: 10/4/17
SITE #: M7
START: 10:45
END: 11:05
LEQ: 39.3
SPEED: _____

SITE SKETCH 3214 SYLVANIA



BACKGROUND NOISE distant planes, birds, schoolkids, day, train horn, jet
MAJOR SOURCES _____
UNUSUAL EVENTS _____
OTHER NOTES _____

Michael Baker Jr., Inc. 2005

3600 NORTH- WORD, SPIRIT, & LIFE MINISTRIES

MEASUREMENT SITE 8

NOISE SURVEY SHEET

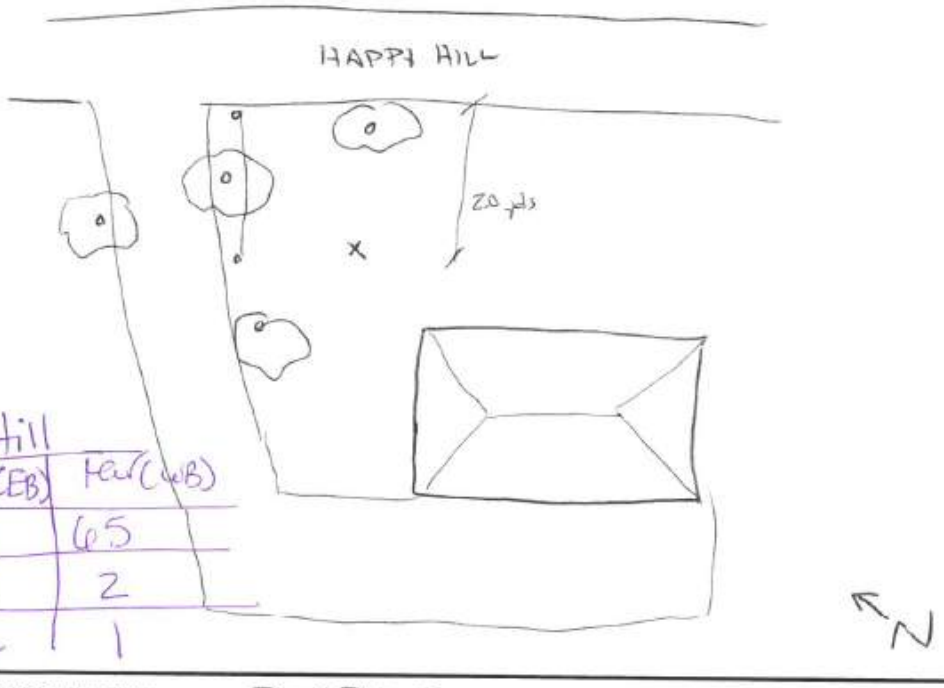
EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744
CALIBRATION: START _____ dB END _____ dB
RESPONSE: FAST _____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 70° SUNNY/CLEAR

15312 HAPPY HILL
DATE: 10/4/17
SITE #: M8
START: 11:26
END: 11:46
LEQ: 59.1
SPEED: _____

TRAFFIC DATA		
ROAD		
AUTOS	81	81
MED TRKS	11	1
HVY TRKS	11	
DURATION		

SITE SKETCH



Happy Hill		
	Near (EB)	Far (WB)
	81	65
	2	2
	2	1

BACKGROUND NOISE PROP PLANE
MAJOR SOURCES _____
UNUSUAL EVENTS _____
OTHER NOTES _____

Michael Baker Jr., Inc. 2005

MEASUREMENT SITE 9

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744
CALIBRATION: START _____ dB END _____ dB
RESPONSE: FAST _____ SLOW X A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: 74° CLEAR

TRAFFIC DATA

ROAD		
AUTOS		165
MED TRKS	III	
HVY TRKS	III	
DURATION		

SCH BUS 1

DATE: 10/4/17
SITE #: M9
START: 12:42
END: 1:02
LEQ: 72.8
SPEED: _____

SITE SKETCH

Jeff Davis

	Near (SB)	Far (NB)
Cars	165	140
MT	3	2
HT	3	—

← N

BACKGROUND NOISE _____
MAJOR SOURCES _____
UNUSUAL EVENTS _____
OTHER NOTES _____

Michael Baker Jr., Inc. 2005

Glen at Colonial Heights, Sign "Development Plan Pending"

APPENDIX D: WARRANTED, FEASIBLE, AND REASONABLE WORKSHEET

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	14-Jan-18
Project No. and UPC:	N/A - Chesterfield County (CDOT) Project
County:	Chesterfield
District:	N/A - Chesterfield County (CDOT) Project
Barrier System ID:	Barrier A
Community Name and/or CNE#	A
Noise Abatement Category(s)	B
Design phase:	Preliminary design

Warranted

1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	NA
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	NA
c.	Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	No
b.	Project causes a substantial noise increase of 10 dB(A) or more?	Yes

Feasibility

1	Impacted receptor units	
a.	Number of impacted receptor units:	1
b.	Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL):	1
c.	Percentage of impacted receptor units receiving 5 dB(A) or more IL	100%
d.	Is the percentage 50 or greater?	Yes
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	NA

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	18,892 SF
b.	Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	1
c.	Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	0
d.	Total number of benefited receptors.	1
e.	Surface Area per benefited receptor unit. (ft^2/BR)	18,892 SF/BR
f.	Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	No
g.	Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	Yes
2	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	1,098 ft
b.	Height range of the proposed noise barrier. (ft)	14-20
c.	Average height of the proposed noise barrier. (ft)	17 ft
d.	Cost per square foot. ($/$ft^2$)	$48/SF
e.	Total Barrier Cost ($)	$906,816
f.	Barrier Material	NA
3	**Community Desires Related to the Barrier** Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to “decision” block and answer “no” to reasonableness question. As the reason for this decision, state that “The majority of the impacted receptor unit owners do not desire the barrier.”	Yes

Decision	
Is the Noise Barrier(s) WARRANTED?	Yes
Is the Noise Barrier(s) FEASIBLE?	Yes
Is the Noise Barrier(s) REASONABLE?	No

Additional Reasons for Decision:

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	14-Jan-18
Project No. and UPC:	N/A - Chesterfield County (CDOT) Project
County:	Chesterfield
District:	N/A - Chesterfield County (CDOT) Project
Barrier System ID:	Barrier B
Community Name and/or CNE#	B
Noise Abatement Category(s)	B
Design phase:	Preliminary design

Warranted

1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	NA
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	NA
c.	Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	No
b.	Project causes a substantial noise increase of 10 dB(A) or more?	Yes

Feasibility

1	Impacted receptor units	
a.	Number of impacted receptor units:	1
b.	Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL):	1
c.	Percentage of impacted receptor units receiving 5 dB(A) or more IL	100%
d.	Is the percentage 50 or greater?	Yes
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	NA

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	63,026 SF
b.	Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	1
c.	Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	1
d.	Total number of benefited receptors.	2
e.	Surface Area per benefited receptor unit. (ft^2/BR)	31,513 SF/BR
f.	Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	No
g.	Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	No
2	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	2,101 ft
b.	Height range of the proposed noise barrier. (ft)	-30 ft
c.	Average height of the proposed noise barrier. (ft)	30 ft
d.	Cost per square foot. ($/$ft^2$)	$48/SF
e.	Total Barrier Cost ($)	$3,025,248
f.	Barrier Material	NA
3	**Community Desires Related to the Barrier** Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to “decision” block and answer “no” to reasonableness question. As the reason for this decision, state that “The majority of the impacted receptor unit owners do not desire the barrier.”	Yes

Decision	
Is the Noise Barrier(s) WARRANTED?	Yes
Is the Noise Barrier(s) FEASIBLE?	Yes
Is the Noise Barrier(s) REASONABLE?	No

Additional Reasons for Decision:
Design Goal not reached

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	14-Jan-18
Project No. and UPC:	N/A - Chesterfield County (CDOT) Project
County:	Chesterfield
District:	N/A - Chesterfield County (CDOT) Project
Barrier System ID:	Barrier C
Community Name and/or CNE#	C
Noise Abatement Category(s)	B
Design phase:	Preliminary design

Warranted

1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	NA
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	NA
c.	Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	No
b.	Project causes a substantial noise increase of 10 dB(A) or more?	Yes

Feasibility

1	Impacted receptor units	
a.	Number of impacted receptor units:	2
b.	Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL):	2
c.	Percentage of impacted receptor units receiving 5 dB(A) or more IL	100%
d.	Is the percentage 50 or greater?	Yes
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	NA

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	45,265 SF
b.	Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	2
c.	Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	1
d.	Total number of benefited receptors.	3
e.	Surface Area per benefited receptor unit. (ft^2/BR)	15,088 SF/BR
f.	Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	No
g.	Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	Yes
2	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	1,939 ft
b.	Height range of the proposed noise barrier. (ft)	18-24
c.	Average height of the proposed noise barrier. (ft)	23 ft
d.	Cost per square foot. ($/$ft^2$)	$48/SF
e.	Total Barrier Cost ($)	$2,172,720
f.	Barrier Material	NA
3	**Community Desires Related to the Barrier** Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to “decision” block and answer “no” to reasonableness question. As the reason for this decision, state that “The majority of the impacted receptor unit owners do not desire the barrier.”	Yes

Decision	
Is the Noise Barrier(s) WARRANTED?	Yes
Is the Noise Barrier(s) FEASIBLE?	Yes
Is the Noise Barrier(s) REASONABLE?	No

Additional Reasons for Decision:
None

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	14-Jan-18
Project No. and UPC:	N/A - Chesterfield County (CDOT) Project
County:	Chesterfield
District:	N/A - Chesterfield County (CDOT) Project
Barrier System ID:	Barrier D & F
Community Name and/or CNE#	D & F
Noise Abatement Category(s)	B
Design phase:	Preliminary design

Warranted

1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	NA
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	NA
c.	Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	No
b.	Project causes a substantial noise increase of 10 dB(A) or more?	Yes

Feasibility

1	Impacted receptor units	
a.	Number of impacted receptor units:	7
b.	Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL):	5
c.	Percentage of impacted receptor units receiving 5 dB(A) or more IL	71%
d.	Is the percentage 50 or greater?	Yes
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	NA

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	59,747 SF
b.	Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	5
c.	Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	11
d.	Total number of benefited receptors.	16
e.	Surface Area per benefited receptor unit. (ft^2/BR)	3,734 SF/BR
f.	Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	No
g.	Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	Yes
2	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	1,832 ft
b.	Height range of the proposed noise barrier. (ft)	13-22
c.	Average height of the proposed noise barrier. (ft)	19 ft
d.	Cost per square foot. ($/$ft^2$)	$48/SF
e.	Total Barrier Cost ($)	$2,867,856
f.	Barrier Material	NA
3	**Community Desires Related to the Barrier**	
	Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to “decision” block and answer “no” to reasonableness question. As the reason for this decision, state that “The majority of the impacted receptor unit owners do not desire the barrier.”	Yes

Decision	
Is the Noise Barrier(s) WARRANTED?	Yes
Is the Noise Barrier(s) FEASIBLE?	Yes
Is the Noise Barrier(s) REASONABLE?	No

Additional Reasons for Decision:
None

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	14-Jan-18
Project No. and UPC:	N/A - Chesterfield County (CDOT) Project
County:	Chesterfield
District:	N/A - Chesterfield County (CDOT) Project
Barrier System ID:	Barrier E & G
Community Name and/or CNE#	E & G
Noise Abatement Category(s)	B, D
Design phase:	Preliminary design

Warranted

1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	NA
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	NA
c.	Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	Yes
b.	Project causes a substantial noise increase of 10 dB(A) or more?	Yes

Feasibility

1	Impacted receptor units	
a.	Number of impacted receptor units:	75
b.	Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL):	53
c.	Percentage of impacted receptor units receiving 5 dB(A) or more IL	71%
d.	Is the percentage 50 or greater?	Yes
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	NA

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	105,006 SF
b.	Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	53
c.	Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	1
d.	Total number of benefited receptors.	54
e.	Surface Area per benefited receptor unit. (ft^2/BR)	1,945 SF/BR
f.	Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	No
g.	Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	Yes
2	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	7,726 ft
b.	Height range of the proposed noise barrier. (ft)	1O-16
c.	Average height of the proposed noise barrier. (ft)	14 ft
d.	Cost per square foot. ($/$ft^2$)	$48/SF
e.	Total Barrier Cost ($)	$5,040,288
f.	Barrier Material	NA
3	**Community Desires Related to the Barrier** Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to “decision” block and answer “no” to reasonableness question. As the reason for this decision, state that “The majority of the impacted receptor unit owners do not desire the barrier.”	Yes

Decision	
Is the Noise Barrier(s) WARRANTED?	Yes
Is the Noise Barrier(s) FEASIBLE?	Yes
Is the Noise Barrier(s) REASONABLE?	No

Additional Reasons for Decision:
None

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	14-Jan-18
Project No. and UPC:	N/A - Chesterfield County (CDOT) Project
County:	Chesterfield
District:	N/A - Chesterfield County (CDOT) Project
Barrier System ID:	Barrier J
Community Name and/or CNE#	J
Noise Abatement Category(s)	B
Design phase:	Preliminary design

Warranted

1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	NA
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	NA
c.	Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	Yes
b.	Project causes a substantial noise increase of 10 dB(A) or more?	Yes

Feasibility

1	Impacted receptor units	
a.	Number of impacted receptor units:	5
b.	Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL):	0
c.	Percentage of impacted receptor units receiving 5 dB(A) or more IL	0%
d.	Is the percentage 50 or greater?	No
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	NA

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	0 SF
b.	Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	0
c.	Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	0
d.	Total number of benefited receptors.	0
e.	Surface Area per benefited receptor unit. (ft^2/BR)	#DIV/0!
f.	Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	#DIV/0!
g.	Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	No
2	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	0 ft
b.	Height range of the proposed noise barrier. (ft)	- ft
c.	Average height of the proposed noise barrier. (ft)	0 ft
d.	Cost per square foot. ($/$ft^2$)	$48/SF
e.	Total Barrier Cost ($)	$0
f.	Barrier Material	NA
3	**Community Desires Related to the Barrier** Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to “decision” block and answer “no” to reasonableness question. As the reason for this decision, state that “The majority of the impacted receptor unit owners do not desire the barrier.”	Yes

Decision	
Is the Noise Barrier(s) WARRANTED?	Yes
Is the Noise Barrier(s) FEASIBLE?	No
Is the Noise Barrier(s) REASONABLE?	No

Additional Reasons for Decision:
Happy Hill Road and US 1 are primary contributors to total highway traffic noise source.

Appendix E: List of Preparers and Reviewers

Andrew P. Kuchta, Air & Noise Technical Manager, 35 years experience performing noise analyses for more than half of the State DOTs throughout the United States, numerous state EPA's, several Turnpike/Toll Road Agencies, several federal level projects (including a 10-year long 24/7 analysis for the NY-NJ District of the Army Corps of Engineers and various projects for the US-VISIT program under the Department of Homeland Security), numerous FAA airport noise analyses, and several commuter and freight train projects. Various certifications with FHWA, FAA, EPA and NHI, including TNM. Performed TNM computer modeling, mitigation analysis, initial QAQC and report writing.

Robyn Hartz, Michael Baker International, Air Quality & Acoustic Scientist, ~14 years experience performing noise analysis for many State DOTs, TNM certification. Performed filed work/noise measurements and TNM computer modeling.

APPENDIX F: TRAFFIC DATA

The following is the excel spreadsheet provided by CDOT to be used in the noise analysis. The existing year traffic is shown on top, then followed by the proposed build alternative volumes. The road names were also edited for clarity.

Existing Year					Truck %		Hourly	Peak Hour		
Roadway	**AADT**	**Direction**	**K Factor**	**Directional Factor**	**MT**	**HT**	**Volume**	**Cars**	**MT**	**HT**
Branders Bridge	3100	NB	0.106	0.603	0.01	0.02	198	192	2	4
	3100	SB	0.106	0.397	0.01	0.02	130	126	1	3
Harrowgate	11000	NB	0.095	0.586	0.01	0	612	606	6	0
	11000	SB	0.095	0.414	0.01	0	433	429	4	0
Happy Hill	9200	NB	0.104	0.535	0.01	0.01	512	502	5	5
	9200	SB	0.104	0.465	0.01	0.01	445	437	4	4
Route 1-95	23100	NB	0.09	0.562	0.01	0.02	1168	1133	12	23
	29600	SB	0.09	0.438	0.01	0.02	1167	1132	12	23
US Route 1	15000	NB	0.088	0.571	0	0.02	754	739	0	15
	15000	SB	0.088	0.429	0	0.02	566	555	0	11
Ruffin Mill Road	5400	EB	0.105	0.781	0.01	0.01	443	435	4	4
	5400	WB	0.105	0.219	0.01	0.01	124	122	1	1

2042 Build Traffic					Truck %		Hourly	Peak Hour		
Roadway	**AADT**	**Direction**	**K Factor**	**Directional Factor**	**MT**	**HT**	**Volume**	**Cars**	**MT**	**HT**
	7600	NB	0.106	0.603	0.01	0.02	486	471	5	10
	7600	SB	0.106	0.397	0.01	0.02	320	311	3	6
	5100	NB	0.106	0.603	0.01	0.02	326	316	3	7
Branders Bridge	5100	SB	0.106	0.397	0.01	0.02	215	209	2	4
	14400	NB	0.095	0.586	0.01	0	802	794	8	0
Harrowgate	14400	SB	0.095	0.414	0.01	0	566	560	6	0
	12000	NB	0.104	0.535	0.01	0.01	668	654	7	7
	12000	SB	0.104	0.465	0.01	0.01	580	568	6	6
	13000	NB	0.104	0.535	0.01	0.01	723	709	7	7
Happy Hill	13000	SB	0.104	0.465	0.01	0.01	629	617	6	6
	40650	NB	0.09	0.562	0.01	0.02	2056	1994	21	41
Route 1-95	40650	SB	0.09	0.438	0.01	0.02	1602	1554	16	32
	17000	EB	0.1	0.8	0.05	0.05	1360	1224	68	68
E/W Freeway	17000	WB	0.1	0.2	0.05	0.05	340	306	17	17
	20600	NB	0.088	0.571	0	0.02	1035	1014	0	21
US Route 1	20600	SB	0.088	0.429	0	0.02	778	762	0	16
	24100	NB	0.105	0.781	0.01	0.01	1976	1936	20	20
Ruffin Mill Road	24100	SB	0.105	0.219	0.01	0.01	554	542	6	6
	17000	EB	0.1	0.3	0.05	0.05	510	458	26	26
E/W Freeway	17000	WB	0.1	0.7	0.05	0.05	1190	1070	60	60

APPENDIX G: HB 2577 (AMENDED BY HB 2025)

Comment: Is noise reducing design feasible in lieu of construction of noise walls or sound barriers? For example, the roadway alignment can be shifted away from noise sensitive receptors or the roadway can be placed in deep cut.

Response: This alignment is the current preferred alignment chosen from a group of approximately six build alternatives, selected as the best fit for this area. At this time, there are no noise barriers proposed to be carried into final design. Horizontal alignment modifications are impractical because this project is also potentially to be amalgamated with a parallel future rail line if the development is warranted. Vertical changes should be investigated once any preliminary rail line decisions are made to see if the road can be placed deeper in cut in locations between the grade-separated interchanges/overpasses/underpasses. However, due to possible engineering constraints, locations immediately near these above positions would likely have to be maintained as currently designed so as to provide the proper clearances and/or ramp grades to/from the East-West Freeway. (Timmons Group/Michael Baker International)

Comment: Can the project support the use of low noise pavement in lieu of construction of noise walls or sound barriers?

Response: The Virginia Department of Transportation is not authorized by the Federal Highway Administration to use "quiet pavement" at this time as a form of noise mitigation. Upon completion of the Quiet Pavement Pilot Program and approval from FHWA, the use of "quiet pavement" will be given additional consideration. (LJ Muchenje, C.O. Environmental, VDOT)

Comment: Can landscaping be utilized to act as a visual screen if visual screening is required?

Response: During final design, efforts to further minimize noise impacts will be addressed. Such measures may include landscaping and berms as visual screens. These landscaping measures must be placed outside of the clear zone, must not decrease driver sight distance, and must not require additional right of way. (Timmons Group/Michael Baker International)